

IOWA DEPARTMENT OF NATURAL RESOURCES

LEADING IOWANS IN CARING FOR OUR NATURAL RESOURCES

CHUCK GIPP, DIRECTOR | BRUCE TRAUTMAN, DEPUTY DIRECTOR

Lake Restoration Program 2015 Report and 2016 Plan

Submitted To

Joint Appropriations Subcommittee on Transportation, Infrastructure,
and Capitals
and
Legislative Services Agency

Submitted By

Iowa Department of Natural Resources
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Executive Summary

The 2015 Iowa Lake Restoration Report and 2016 Plan outlines the need and demand for lake restoration in Iowa; identifies a prioritized group of lakes and the associated costs for restoration; and provides the status of past appropriated legislatively directed funding.

Iowans value water quality and desire safe healthy lakes that provide a full complement of aesthetic, ecological and recreational benefits. A recently completed water-based recreational use survey by Iowa State University found that six of 10 Iowans visit our lakes multiple times each year and spend \$1.6 billion annually in their pursuit of outdoor lake recreation. The most popular activities are fishing, picnicking, wildlife viewing, boating, hiking and biking, and swimming and beach use. The number of household trip visitations to Iowa lakes continues to increase; lake use in 2009 was 27% greater than visitation rates from 2002 through 2005. In addition, visitations at lakes that have completed watershed and lake improvements efforts continue to exceed the state average and their own pre-renovation visitation levels.

Legislative Action

Goals of Iowa's Lake Restoration Program are improved water quality; a diverse, balanced aquatic community and sustained public use benefits.

Many of our Iowa Lakes, similar to our nation's lakes, are impaired and suffer from excessive algae growth and sedimentation due to nutrient loading and soil loss. The Iowa Department of Natural Resources (DNR) Lake Restoration Program (LRP) focus is on restoring Iowa's significant publicly-owned lakes. This report provides our plan to restore our Iowa public lakes and improve lake water quality, which will lead to increased lake use and long-term infrastructure protection.

In the 81st General Assembly, with HF 2782, the legislature responded to our need for improving Iowa's lakes by creating the Lake Restoration Plan and Report, known as the Lake Restoration Program. Included in HF2782, Section (26) of The Endowment for Iowa's Health Account is a process and criteria for completing successful lake restoration projects. It directs the DNR to report annually its plans and recommendations for lake restoration funding, as well as progress and results from projects funded by this legislation. This report has been prepared in accordance with these requirements. In addition, it describes some of the important work done by local, state and federal partners. ***These partnerships, along with sound scientific information, are the foundation of current and future successful lake restoration projects.***

Funding for the Lake Restoration Program (LRP) is currently appropriated on an annual basis. We anticipate that at the current annual level of \$9.6 million per year the DNR can stay on schedule with implementing restoration efforts at the thirty-five lakes currently prioritized in the ten-year plan.

Lake Restoration Program

The DNR modeled the Lake Restoration Program after the Federal Clean Lakes Program established in the 1970's. For the purpose of Iowa's Lake Restoration Program, the DNR defines "significant, publicly-owned lakes" as those publicly-owned lakes that meet all of the following criteria:

- are maintained principally for public use;
- are multi use systems capable of supporting a viable sport fishery and recreational opportunities;
- have a surface water area of at least 10 acres;
- have a watershed to lake surface area ratio of less than 200:1;
- are not federal flood control impoundments (exception is Rathbun Reservoir due to a watershed to lake surface area ratio that is less than 200:1); and
- are not lakes used solely as water supply reservoirs.

The goal is to invest money on projects with multiple benefits such as improved water quality and increased public use, while taking into account feasibility of restoration. Science based prioritization has been our most effective tool in targeting projects of value to the state.

DNR is currently updating the process to rank our significant publically owned lakes in terms of their potential for meeting program goals. This assessment will incorporate information on the public benefit of an individual lakes, feasibility of restoration (can we be successful?), and the current status of the water quality.

Lake Restoration Program - Project Goals

The department recommends funding for lake restoration projects that are designed to achieve the following goals:

- Ensure a cost effective, positive return on investment for the citizens of Iowa.
- Ensure local community commitment to lake and watershed protection.
- Ensure significant improvement in water clarity, safety, and quality of Iowa lakes.
- Provide for a sustainable, healthy, functioning lake system.
- Result in the removal of the lake from the impaired waters list.

Lake Restoration Program - Process and Criteria

The process and criteria to recommend funding for lake restoration projects are:

- The department maintains a list of not more than thirty-five significant publicly owned lakes prioritized for funding based on the feasibility of each lake for restoration and the use or potential use of the lake, if restored. The department recommends these lake projects as a priority for funding so long as progress toward completion of the projects remained consistent with the goals of the program.
- The department meets with representatives of communities where prioritized lakes are located to provide an initial lake restoration assessment and to explain the process and criteria for receiving lake restoration funding.

- Communities with lakes not included on the current list of thirty-five significant publicly owned lakes prioritized for funding may petition the Director of the department for a preliminary assessment of the lake for inclusion in the program (i.e. does the lake meet the program definition of significant, publicly-owned lake and does it rank well relative to other lakes in terms of potential for meeting program goals) and an explanation of the funding process and criteria.
- Projects need to follow the directives to the department regarding Project Goals, Process and Criteria, and Restoration Plan Guidelines from 2006 State Legislation (HF2782).

The Lake Restoration Program updates their 10-year plan on an annual basis to reflect the timeline and potential budget needs for lake restoration efforts at the current thirty-five significant publicly owned lake prioritized for funding (Table 1 and Table 2). This includes a five-year capital plan for on-going projects and a long-term planning budget based on current conceptual plans for restoration and comparison to investment on similar past projects.

- Lakes highlighted in orange, with the exception of Three Mile Lake, are expected to complete on-going restoration efforts during FY17. Initial funding for Three Mile Lake is to help renovate the fishery and begin planning for restoration efforts that will take place within the FY22-FY26 timeframe.
- Lakes highlighted in green are active projects undergoing implementation of watershed or in-lake restoration efforts.
- Program activities that maintain a budget line item are highlighted in blue. These include items like continued statewide lake economic and water quality assessments used to guide our investments in lake improvement, program oversight and engineering services.
- Lakes highlighted in purple are typically in the early planning stages or developing water quality improvement plans. Moving forward with in-lake restoration efforts will be dependent on the community's interest and commitment to the project and adequate control of nutrients and sediment from the watershed. In a few cases, watershed improvement activities have already been initiated at these lakes.

Table 1. Lake Restoration Program Five Year Capital Plan

Project Name	County	LRP FY17	LRP FY18	LRP FY19	LRP FY20	LRP FY21	Total	Description
Center L.	Dickinson	\$100,000					\$100,000	Shoreline, fish barrier, wetland
Five Island L.	Palo Alto	\$125,000					\$125,000	Sediment study, carp control
Lake Miami	Monroe	\$100,000					\$100,000	Watershed ponds
Mariposa L.	Jasper	\$150,000					\$150,000	Shoreline, dredging, spillway repair
Pleasant Creek L.	Linn	\$175,000					\$175,000	Shoreline protection
Three Mile Lake	Union	\$300,000					\$300,000	Shoreline, wetland, ponds, fish renovation
Union Grove L.	Tama	\$225,000					\$225,000	Gate-valve, fish barrier, shoreline, dredging
Black Hawk L.	Sac	\$1,450,000	\$2,250,000	\$2,300,000	\$2,450,000	\$2,550,000	\$11,000,000	Containment site, watershed, dredging
Blue L.	Monona	\$250,000	\$750,000	\$750,000	\$750,000	\$750,000	\$3,250,000	Watershed, containment site, in-lake
Central Park L.	Jones	\$180,000	\$180,000	\$180,000	\$180,000	\$180,000	\$900,000	In-lake restoration
Easter L.	Polk	\$600,000	\$600,000	\$600,000	\$600,000	\$600,000	\$3,000,000	Watershed Phase 2 and 3, in-lake
Hickory Grove L.	Story	\$400,000	\$250,000	\$250,000	\$250,000	\$250,000	\$1,400,000	Watershed, shoreline, in-lake restoration
IA Great Lakes	Dickinson	\$750,000	\$750,000	\$750,000	\$750,000	\$750,000	\$3,750,000	Watershed improvement, water quality projects
Kent Park L.	Johnson	\$300,000	\$300,000	\$300,000	\$300,000	\$300,000	\$1,500,000	Watershed improvement
Lacey Keosauqua L.	Van Buren	\$100,000	\$250,000	\$250,000	\$250,000	\$250,000	\$1,100,000	Watershed BMPs, in-lake planning
Lake Geode	Henry	\$425,000	\$425,000	\$425,000	\$425,000	\$425,000	\$2,125,000	Sediment ponds, in-lake restoration
Lake Keomah	Mahaska	\$320,000	\$320,000	\$320,000	\$320,000	\$320,000	\$1,600,000	Watershed BMPs, in-lake planning
Lake Manawa	Pottawattamie	\$1,600,000	\$1,600,000	\$1,600,000	\$1,600,000	\$1,600,000	\$8,000,000	Mosquito and Indian Creeks, dredging
Lake of the Hills	Scott	\$100,000	\$225,000	\$225,000	\$225,000	\$225,000	\$1,000,000	Watershed assessment
Rathbun Reservoir	Appanoose	\$300,000	\$350,000	\$350,000	\$350,000	\$350,000	\$1,700,000	Watershed, 1135 Project Shoreline
Storm Lake	Buena Vista	\$800,000	\$500,000	\$450,000	\$300,000	\$200,000	\$2,250,000	Dredging, island stabilization, in-lake
Lake Assessment		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000	\$500,000	Lake Assessment
Minors		\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$750,000	Minors
Proj. Mgmt./Eng.		\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$2,500,000	Project management and engineering services
Shallow Lakes		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000	\$500,000	Rice Lake, Little Swan Lake, Elm Lake
		\$9,600,000	\$9,600,000	\$9,600,000	\$9,600,000	\$9,600,000	\$48,000,000	

Table 2. Lake Restoration Program Long Term Planning Budget

Project Name	County	Long Term Planning Budget					Total
		LRP FY22	LRP FY23	LRP FY24	LRP FY25	LRP FY26	
Blue L.	Monona	\$750,000					\$750,000
Black Hawk L.	Sac	\$1,370,000	\$1,320,000				\$2,690,000
Arbor L.	Poweshiek	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$750,000
Badger Creek L.	Madison	\$1,200,000	\$1,200,000	\$1,570,000	\$1,450,000	\$1,550,000	\$6,970,000
Big Creek L.	Polk	\$300,000	\$1,100,000	\$1,175,000	\$1,100,000	\$775,000	\$4,450,000
Diamond L.	Poweshiek	\$150,000	\$150,000	\$200,000	\$190,000	\$200,000	\$890,000
George Wyth L.	Black Hawk	\$150,000	\$150,000	\$200,000	\$190,000	\$200,000	\$890,000
Hannen L.	Benton	\$175,000	\$175,000	\$175,000	\$175,000	\$175,000	\$875,000
IA Great Lakes	Dickinson	\$750,000	\$750,000	\$750,000	\$750,000	\$750,000	\$3,750,000
Otter Creek Lake	Tama	\$240,000	\$240,000	\$310,000	\$290,000	\$310,000	\$1,390,000
Pine L. _Upper/Lower	Hardin	\$190,000	\$190,000	\$250,000	\$230,000	\$250,000	\$1,110,000
Rathbun Reservoir	Appanoose	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$1,250,000
Rock Creek L.	Jasper	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$5,000,000
Silver Lake	Delaware	\$175,000	\$175,000	\$230,000	\$220,000	\$230,000	\$1,030,000
Silver Lake	Dickinson	\$250,000	\$250,000	\$325,000	\$730,000	\$775,000	\$2,330,000
Silver Lake	Palo Alto	\$375,000	\$375,000	\$495,000	\$465,000	\$485,000	\$2,195,000
Swan Lake	Carroll	\$200,000	\$200,000	\$260,000	\$250,000	\$260,000	\$1,170,000
Three Mile Lake	Union	\$575,000	\$575,000	\$750,000	\$700,000	\$740,000	\$3,340,000
Twin L. _North/South	Calhoun	\$500,000	\$500,000	\$660,000	\$610,000	\$650,000	\$2,920,000
Lake Assessment		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000	\$500,000
Minors		\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$750,000
Proj. Mgmt./Eng.		\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$2,500,000
Shallow Lakes		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000	\$500,000
		\$9,600,000	\$9,600,000	\$9,600,000	\$9,600,000	\$9,600,000	\$48,000,000

Lake Restoration Program – Water Quality Improvement Plan Guidelines

The department works with communities to develop a joint lake restoration action plan.

- At a minimum, each joint action plan documents the causes, sources, and magnitude of lake impairment, evaluates the feasibility of the lake and watershed restoration options, establishes water quality goals and a schedule for attainment, assesses the economic benefits of the project, identifies the sources and amounts of any leveraged funds, and describes the community's commitment to the project, including local funding.
- The community's commitment to the project may include moneys to fund a lake diagnostic study and watershed assessment, including development of a Water Quality Improvement Plan.

Each joint lake restoration plan complies with the following guidelines:

- Biologic controls will be utilized to the maximum extent, wherever possible.
- If proposed, dredging of the lake will be conducted to gain water quality benefits and to a depth that results in desired water quality benefits unless a combination of biologic and structural controls is sufficient to assure water quality targets will be achieved at a shallower average water depth.
- The costs of lake restoration will include the maintenance costs of improvements to the lake.
- Delivery of phosphorous and sediment from the watershed will be controlled and control structures will be in place before lake restoration begins.

- The department will evaluate the joint action plans and prioritize the plans based on the criteria required by the program.

In-lake, along with watershed management, will meet or exceed the following water quality targets:

- Clarity - A four and one half foot secchi depth will be achieved fifty percent of the time from April 1 through September 30.
- Safety - Beaches will meet water quality standards for recreational use.
- Biota - A diverse, balanced, and sustainable aquatic community will be maintained.
- Sustainability - The water quality benefits of the restoration efforts will be sustained for at least fifty years.

[Note: Appendix A (2006 State Legislation HF2782) provides a summary of directives to the department regarding Project Goals, Process and Criteria, and Restoration Plan Guidelines for the Lake Restoration Program.]

Lake Restoration Program – Status

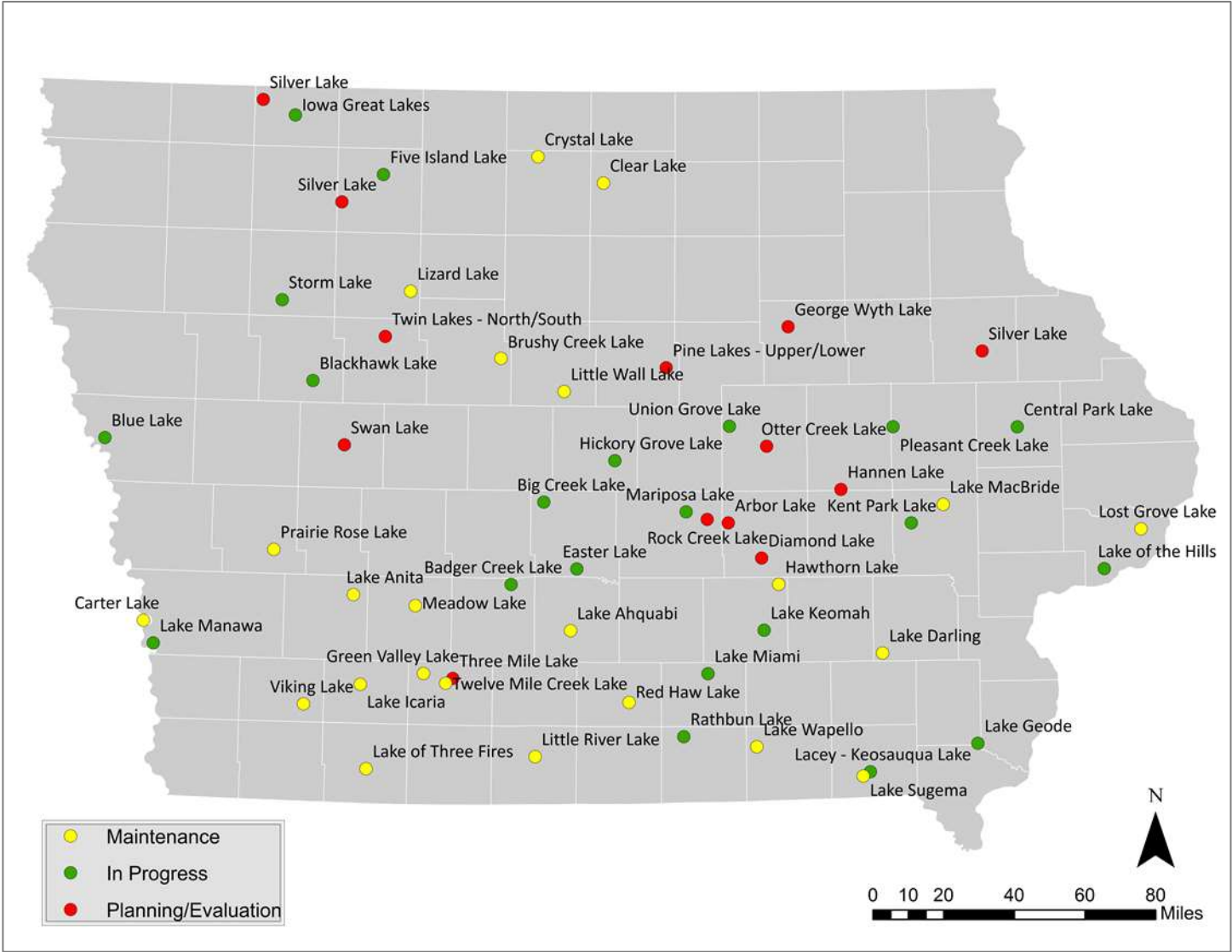
The intent of the program is to develop and administer lake restoration projects that achieve the following goals: ensure a cost-effective investment for the State of Iowa; foster a community commitment to lake and watershed protection; and provide significant improvement to the quality of Iowa lakes.

Major water quality improvement initiatives are completed or near completion at twenty-four lakes. Current program activities are in progress at an additional twenty-two lakes throughout the state and in the initial community outreach, evaluation or planning stage at thirteen lakes (Figure 1).

Timelines for many of these projects usually fall within a three to five year period. However, dredging or major construction projects may take even longer. Contractors face substantial costs to mobilize and set up lake improvement operations and this critical work needs multiple year commitments to secure contractors. As such, the most practical and efficient way to complete these undertakings are as continuous projects. The Lake Restoration Program has matured to the point where a number of multi-step projects are concurrently at the implementation phase.

*Iowa has completed restoration work at **24 lakes**, with **22 projects** underway, and **13 projects** in the initial planning stages.*

Figure 1. DNR Lake Restoration Program Status



Lake Restoration Program – Funding

The source of FY2016 funding for the Lake Restoration Program was an appropriation from the Rebuild Iowa Infrastructure Fund under HF650 (Figure 2). Under this appropriation, the DNR - LRP received \$9.6 million dollars in FY2016 to meet contracted obligations and budgeted program activities (Tables 3, 4, and 5).

DNR Lake Restoration Program (LRP) Funding as of FY16 (11/30/2015)

Carry Forward from FY14	\$10,261,797
FY15 Lake Restoration Program Funding	\$9,600,000
Lake Restoration Program Spent FY15 thru FY16 (11/30/2015)	(\$6,117,150)
FY16 Lake Restoration Program Funding	<u>\$9,600,000</u>
Lake Restoration Program Available Balance as of FY16 (11/30/15)	\$23,344,647
Under Contract - Actual Amount Due	(\$14,395,551)
Under Contract by 6/30/16 - Estimated Cost	<u>(\$8,799,096)</u>
LRP Un-obligated Funds as of FY16 (6/30/16)	\$150,000

Funding from FY2007 through FY2016 of \$80.2 million (approximately \$8 million per year) has enabled the DNR to improve many Iowa's lakes and proceed with implementing projects at a number of our other priority systems (see project summaries in this report). The Lake Restoration Program has now matured to the point where a number of multi-step projects are concurrently at the implementation phase; therefore, we now have more projects ready to start in a given year than we have available dollars to complete restoration at all the active projects.

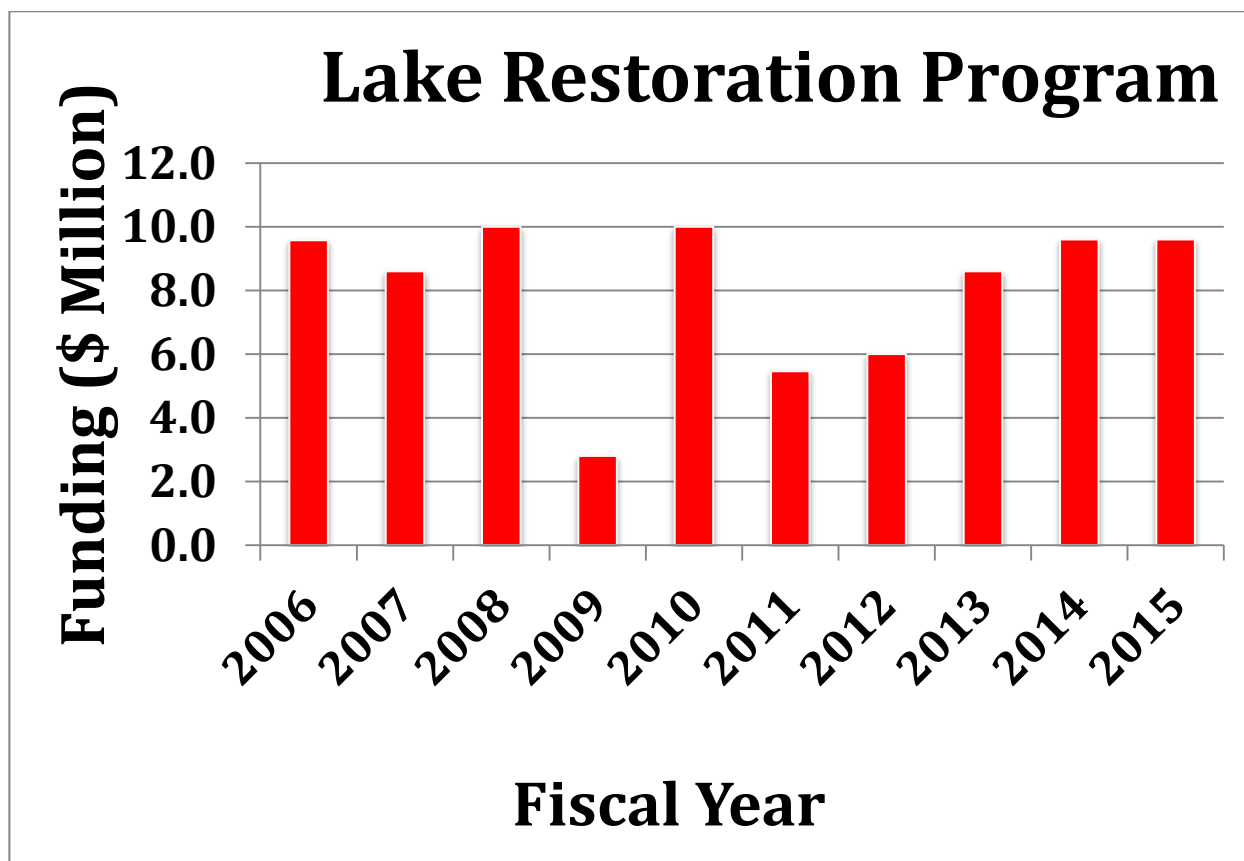
Maintaining flexibility in where the Lake Restoration Program can allocate funding and consistent annual funding is critical for implementing multi-year projects and developing new projects.

The majority of lake restoration projects involve construction phases of watershed and/or in-lake implementation. A typical construction project includes the following phases: project scoping, engineering design, work bid letting, contract development, construction, and inspection. All processes must adhere to the standards and requirements of doing business as a public agency. Certain projects may require easements or land acquisition before construction can begin and/or require approvals and permits such as an archeological investigation for historic properties, an environmental review for threatened or endangered species, COE 404 permit, and DNR floodplains / sovereign lands permit.

Project planning involves working with representatives of the local community to develop a joint restoration plan. For planning purposes, it is necessary that a proper assessment of the lake and watershed is available to provide restoration alternatives to meet given water quality goals. In order to achieve lake restoration goals it is critical that the DNR form effective watershed partnerships. This includes partnerships at the local and administrative levels of government. Local, state and federal programs offer a multitude of programs for financial assistance to landowners for soil conservation and other water quality protection practices.

Building community support and development of partnerships is a long-term commitment from the Lake Restoration Program and is the foundation to the program's success.

Figure 2. DNR Lake Restoration Program Funding History



The Lake Restoration Program cooperates in a variety of cost-share partnerships with local, state and federal entities to accomplish the water quality improvement initiatives described in this report.

On average, there is a 35% cost-share match to Lake Restoration Program funds, which is critical to accomplishing the work detailed in this report and past summaries of LRP activities.

Local groups include associations; such as the IGL - Iowa Great Lakes, LIPA - Lost Island Preservation Association, RRWA - Rathbun Rural Water Association, LPA - Lake Preservation Association (Storm Lake), CLPS - Carter Lake Preservation Society and the LPHC - Lake and Park Holding Corporation (Union Grove) to name a few. The DNR 319 Water Quality Improvement Section, DNR Wildlife, DNR Parks along with the Iowa Department of Agriculture and Land Stewardship – Division of Soil Conservation have worked together to implement watershed BMPs. Non-profit groups; such as DU - Ducks Unlimited, PH - Pheasants Forever and the TNC - The Nature Conservancy have also provided funding for projects. A significant number of Iowa lakes are owned and/or managed by local entities such as County Conservation Boards or Cities. Local agencies have been very active in developing restoration plans and providing resources to these efforts.

Table 3. DNR Lake Restoration Program (LRP) Funding as of FY16 (11/30/2015)

Carry Forward from FY14				\$10,261,797			
FY15 Lake Restoration Program Funding				\$9,600,000			
Total Available Funding at Start of FY15				\$19,861,797			
Project Name	Project Description	County	LRP Spent	Fed	Other	Total Spent	
Administration	Project management		\$714,643			\$714,643	
Badger Creek Lake	Watershed improvement	Madison	\$6,885	\$8,614		\$15,499	
Big Creek Lake	Watershed improvement	Polk	\$226,098			\$226,098	
Black Hawk Lake	Shoreline, in-lake restoration	Sac	\$315,756			\$315,756	
Blue Lake	Fish barriers, sediment basin	Monona	\$199,286			\$199,286	
Carter Lake	In-lake restoration	Pottawattamie	\$53,025			\$53,025	
Central Park Lake	Ponds and wetland enhancement	Jones	\$38,603			\$38,603	
Clear Lake	Ventura Marsh outlet	Cerro Gordo	\$18,087		\$1,467	\$19,554	
Easter Lake	Yeader Creek stabilization, containment site	Polk	\$368,961			\$368,961	
Feasibility Studies	Restoration action plans, monitoring		\$280,007			\$280,007	
Five Island Lake	Dredging	Palo Alto	\$162,428			\$162,428	
Hawthorn Lake	Sediment ponds, watershed BMPs	Mahaska	\$47,868			\$47,868	
IA Great Lakes	Marble-Hottes, watershed improvement	Dickinson	\$587,259			\$587,259	
Lake Darling	In-lake restoration, dredging	Washington	\$51,353			\$51,353	
Lake Geode	Sediment control ponds	Henry	\$93,122	\$93,122		\$186,245	
Lake Manawa	Engineering design, dredging	Pottawattamie	\$450,923			\$450,923	
Mariposa Lake	Engineering design	Jasper	\$25,078			\$25,078	
Minor Projects	Lost Grove, Red Haw, Rock Creek, Keomah	Scott, Lucas, Jasper, Mahaska	\$117,078		\$1,372	\$118,450	
Pleasant Creek Lake	Gate valve replacement	Linn	\$47,112			\$47,112	
Prairie Rose Lake	Grade stabilization structure, dredging	Shelby	\$1,468,231			\$1,468,231	
Shallow Lakes	N/S Twin, Virgin and Silver	Calhoun, Palo Alto	\$219,050		\$22,000	\$241,050	
Storm Lake	Dredging, in-lake improvement	Buena Vista	\$313,491			\$313,491	
Twelve Mile Lake	Wetland construction	Union	\$297,796			\$297,796	
Union Grove Lake	Shoreline, spillway, dredging	Tama	\$15,012			\$15,012	
			\$6,117,150	\$101,736	\$24,839	\$6,243,725	
Carry Forward from FY15				\$13,744,647			
FY16 Lake Restoration Program Funding				\$9,600,000			
Current Balance as of November 30, 2015				\$23,344,647			

Table 4. Lake Restoration Program Funds Under Contract as of FY16 (11/30/2015)

Project Name	Project Description	County	LRP Contracted	Other	Under Contract
Administration	Project management		\$291,667		\$291,667
Black Hawk Lake	Watershed, containment site	Sac	\$746,451		\$746,451
Blue Lake	Fish barrier / restoration	Pottawattamie	\$191,282		\$191,282
Center Lake	Fish barrier, wetland, shoreline	Dickinson	\$79,431		\$79,431
Central Park Lake	Watershed improvement	Jones	\$17,519		\$17,519
Diamond Lake	Spillway / fish barrier	Poweshiek	\$4,304		\$4,304
Easter Lake	Yeader Creek, Ewing Park, in-lake restoration	Polk	\$5,445,085	\$224,330	\$5,669,415
Hawthorn Lake	Sediment ponds	Mahaska	\$191,430		\$191,430
Hickory Grove Lake	Stream restoration	Story	\$199,788		\$199,788
IA Great Lakes	Watershed improvement, water quality projects	Dickinson	\$101,625		\$101,625
Lake Assessment	Lake economic analysis and monitoring		\$194,270	\$253,718	\$447,988
Lake Darling	Dredging and shoreline armoring	Washington	\$271,271	\$482,259	\$753,530
Lake Manawa	Dredging and water quality	Pottawattamie	\$4,383,450		\$4,383,450
Mariposa Lake	Engineering and design	Jasper	\$6,344		\$6,344
Pleasant Creek Lake	Draw down valve replacement	Linn	\$2,143		\$2,143
Prairie Rose Lake	Wetland, dredging	Shelby	\$246,703		\$246,703
Rathbun	Watershed improvement	Appanoose	\$250,000		\$250,000
Shallow Lakes	Walnut Creek Marsh, Rice Lake		\$195,324	\$185,218	\$380,542
Silver Lake	Feasibility study	Palo Alto	\$83,180	\$15,501	\$98,680
Storm Lake	Dredging	Buena Vista	\$813,998		\$813,998
Twin Lakes	Feasibility study	Calhoun	\$117,506		\$117,506
Union Grove Lake	Containment site, gate-valve, fish barrier, shoreline	Tama	\$562,781		\$562,781
			\$14,395,551	\$1,161,025	\$15,556,576

Table 5. Lake Restoration Program Funds Under Contract by end of FY16 (06/30/2016)

Project Name	Project Description	County	LRP Obligated	Fed	Other	Under Contract by 6/30/16
Badger Creek Lake	Sediment control structures	Madison	\$55,500		\$55,500	\$111,000
Black Hawk Lake	Inlet dredging	Sac	\$800,000			\$800,000
Center Lake	Shoreline, fish renovation, wetland and fish barrier	Dickinson	\$779,796		\$15,000	\$794,796
Green Valley Lake	Raise west silt dike	Union	\$140,000			\$140,000
IA Great Lakes	E. Okoboji, Garlock, Apple Jack and Spring Run	Dickinson	\$236,000		\$6,000	\$242,000
Lake Darling	Finish work on restoration project	Washington	\$32,800		\$19,200	\$52,000
Lake Geode	Spillway, 3rd round sediment ponds	Henry	\$205,000	\$200,000		\$405,000
Lake Miami	Watershed ponds	Monroe	\$150,000			\$150,000
Mariposa Lake	Shoreline, dredging, and spillway repair	Jasper	\$1,600,000		\$400,000	\$2,000,000
Pine Lakes	Upper Pine Lake wetland	Hardin	\$50,000		\$400,000	\$450,000
Pleasant Creek Lake	Shoreline protection and access	Linn	\$1,750,000		\$250,000	\$2,000,000
Shallow Lakes	Little Swan Lake		\$150,000			\$150,000
Storm Lake	Storm Lake island stabilization and dredging	Buena Vista	\$1,150,000			\$1,150,000
Union Grove Lake	Dredging	Tama	\$1,700,000			\$1,700,000
			\$8,799,096	\$200,000	\$1,145,700	\$10,144,796
Lake Restoration Program Available Balance as of FY16 (11/30/15)			\$23,344,647			
Under Contract (Actual Amount Due)			\$14,395,551			
Under Contract by 6/30/16 (Estimated Cost)			\$8,799,096			
LRP Un-obligated Funds as of FY16 close (6/30/16)			\$150,000			

Highlighted Success Stories:

Easter Lake (Polk County)

Easter Lake is a 178-acre constructed lake with a watershed to lake area ratio of 36 to 1. Constructed in 1967, Easter Lake began as a lake in an agriculture/suburban watershed that over the years has shifted to a highly developed urban area. Construction activities and storm water issues have contributed greatly to more than a 20% reduction in lake volume. Non-algal turbidity continues to cause the majority of water quality problems, resulting in very low water clarity observed throughout the year at this lake. The Polk CCB owns and manages this area and they continue to work in partnership to accomplish lake and watershed improvements.

Easter Lake is an excellent example of how project partners come together to work towards better water quality in our lakes across the state and provide new/improved recreational opportunities to Iowans. The project timeline below shows the steps being completed to restore this watershed.



- A Technical Advisory Team (TAT) met multiple times from 2007 through 2013 to discuss plans for Easter Lake and the watershed. Representatives from the Polk County Conservation Board, City of Des Moines – Parks and Recreation / Public Works, IDNR – Environmental Services Division / Fisheries / Watershed Improvement Section, Iowa Department of Agriculture and Land Stewardship, Iowa State University, and the Natural Resources Conservation Service have attended these meetings.
- EA Engineering completed a water quality improvement plan for Easter Lake in the fall of 2012. This plan incorporated findings from previous watershed and in-lake research projects. A public meeting was held to inform the public of the proposed improvement and gather feedback.
- A local steering committee was formed from watershed landowners who attended past public meetings. This committee is assisting the TAT throughout the restoration process.
- The Technical Advisory Team received 319 funding in the fall of 2012. These dollars will allowed for watershed practices to be installed to mitigate storm water problems.

Polk SWCD watershed coordinators are working to implement Phase I of the watershed project. Many of the project goals to date have been met and exceeded. 61 practices have been installed from the following funding sources: \$46,060.01 in cost-share dollars from Section 319, \$79,205.17 from IDALS-DSC (WSPF), \$5,234.12 from the City of Des Moines, \$46,053.97 from Polk County Conservation, and \$93,407.08 from homeowners.



Before (left) and after (right) pictures of a permeable paver installation in the Easter Lake Watershed to reduce storm water runoff to the lake.

- The coordinators have made significant strides involving the community and stakeholders in the project. Education activities in 2015 engaged over 1000 people in attendance.
- In addition, the coordinators are now working to outreach with corporate watershed landowners, such as Kum and Go and a large automobile lot.
- Snyder & Associates was hired to work with a subcommittee of the TAT on the in-lake portion of this project. They have recently secured the necessary permits for the in-lake outlet repair and



Volunteers from the community help with forest restoration activities around Easter Lake Park.



dredge work. A contractor was selected to repair the outlet structure and renovate the existing fish rearing pond.

- The City of Des Moines has completed the renovation of Ewing Park. The city is currently in the process of securing easements along Yeader Creek so that additional stabilization structures can be installed to reduce bank erosion.
- Additional watershed work is being completed by the many project partners working at Easter Lake to improve water quality. In early 2015, IDALS and the Watershed Improvement Section

allocated additional funds for the construction of a large sediment basin and grade stabilization structure adjacent to the lake. These two projects plan to reduce over 100 tons of sediment from entering the lake annually.

- The city of Des Moines is also constructing a new multi-use trail around the perimeter of the lake that will draw many new people in the Des Moines Metro area to the lake.
- In the fall of 2015, the lake level was lowered by approximately 5 feet in preparation for shoreline work currently slated for 2016. Clean up days are being planned to help removed unwanted trash and debris from the lake perimeter prior to the completion of shoreline work.

Lost Grove Lake (Scott County)

The Iowa Department of Natural Resources has completed work to construct Lost Grove Lake, Scott County. The project is an investment in Iowa's infrastructure; promoting long-term economic growth; is a watershed/water quality project; and will provide flood protection and soil conservation benefits. The Lost Grove Lake recreation site was selected in 1987. Land acquisition from willing sellers began in 1988 and completed in 2003. The state purchased a total of 1,701 acres of land as the site for this 400 surface acre lake. This recreation project has strong local support from groups such as; the Quad City Conservation Alliance, Pheasants Forever, the Izaak Walton League, Scott County Soil and Watershed Conservation District and the Quad City Bass Club. In addition, the Scott County Soil and Watershed District completed a watershed assessment and implemented water quality projects that have included filter strips, grass waterways, sediment basins and EQIP nutrient and pest management enrollments.

The lake site is located 10 miles north of Davenport, Iowa and now provides public fishing opportunities for the area's 400,000 residents. The lake and surrounding public land will also support outdoor activities such as hunting, wildlife viewing, boating and hiking.

While a campground is not proposed at this time, local or county support could incorporate development of a campground site in the future.



Lost Grove Lake in the summer of 2015

- The Lost Grove Lake and Recreation Area project provided 60 to 75 jobs during the construction phase. Iowa State University Center for Agriculture and Rural Development (CARD) research indicates that a lake of this size that exhibits good water quality will annually provide over 350,000 visits, create approximately \$20 million in local spending and will result in supporting 175 jobs. This project will provide a high quality recreational lake while at the same time providing immediate economic stimulus to the region.



- Project activities included dam construction, shoreline stabilization, boating and shore access, fish habitat enhancement and site access roads. Prior land acquisition, watershed improvements, utility relocation, dam design and road modification funding expenditures have totaled \$4.495 million (Federal Sport Fish Restoration \$2.610M, DNR Fish and Wildlife Trust Fund \$1.00M, State Marine Fuel Tax Fund \$885,000).

- Langman Construction, Inc. was awarded the Fish

Habitat, Riprap, and Shoreline Access phase of the project. The bid was for \$1.17 million. Construction commenced the week of July 25 and was completed on October 7, 2011. J.B. Holland Construction was the lowest bidder (\$4,341,437) on the Lost Grove Lake dam construction project. The NRC approved the bid on June 10, 2010. Dam construction began in July 2010 and was completed summer 2012. Scott County Secondary Roads designed two road culvert risers on Utica Ridge Road (see green dots on map). These risers will temporarily impound water to allow settling of sediment and nutrients, and thus, preserve the water quality of Lost Grove Lake. Arensdorf Excavating & Trucking, Inc., Anamosa, IA received the bid for \$90,089.84. The project was completed in December 2012.

- The boat ramp, parking lot, and pit-vault toilet construction phase of the project was bid in February 2013 and work on the \$920,000 project began in late July 2013. These items were completed in fall 2014.

The lake reached full pool in June of 2015 and has drawn numerous anglers and recreationists over the course of the year. Over 40 boat trailers were counted at the main boat ramp over Memorial Day weekend alone. Fish surveys conducted in 2015 also show the development of an excellent fishery, with muskellunge up to 24 inches, many bluegills between 6 and 7.5 inches, and numerous largemouth bass in the 10-13 inch class sizes.

The lake was formally dedicated on October 7, 2015. Numerous speakers commented on the impact of Lost Grove Lake to the people of Scott County and beyond. Nearly a 100 people came out for the dedication of the lake. Prior to the formal dedication, many standup paddle boarders, windsurfers, swimmers, and even kite surfers were enjoying the lake, since it officially opened to the public in 2014.



Improvements continue to be made around the lake including:

- 911 addresses posted at the entrances to all infrastructure areas.
- Pit-vault toilets were installed at the middle and west boat ramps in August of 2015 (MFT \$90,155)
- A maintenance agreement was established with DJ Laughlin (D&D LawnCare) to mow grass near infrastructure areas, maintenance of trails, trash removal, and snow plowing (at middle boat ramp); this was the second year a maintenance agreement was established with a private contractor.
- Efforts were continued to post wayfinding signage on the perimeter on the property.
- Established an agreement with Scott County Secondary Roads to complete maintenance of interior shoreline/boat ramp access roads.

Future work at the lake includes:

- Interior Road Paving Project, \$435,000, MFT 50%/Federal DJ 50%
- Middle Pit Vault Toilet Construction, \$75,000, MFT 100%
- Installation of additional wayfinding signage on perimeter of the Lost Grove Lake W.M.A.

Water quality at this new lake looks excellent, with low nutrient and suspended solids levels promoting the healthy establishment of some aquatic vegetation and water clarity over 6 feet observed in throughout the summer of 2015.

Lake Restoration Program (LRP) – Projects in Progress

Badger Creek Lake (Madison County)

Badger Creek Lake has great potential to become one of Iowa's premier recreational areas due to its proximity to the Des Moines Metropolitan Area and its size and configuration. However, current water quality at the lake is poor, with heavy siltation and frequent nuisance algae blooms plaguing this 269



A field day was held June 15th in the watershed to help producers understand how BMPs implemented will improve water quality.

acre lake. These water quality problems have led to several impairments for the primary contact and aquatic life uses at the lake.

The Lake Restoration Program has identified Badger Creek Lake as a priority for future funding and restoration efforts. Implementation of the comprehensive Watershed Management Plan is currently the most critical step towards sustaining Badger Creek Lake's recreational viability. The management plan establishes water quality goals and builds on the current efforts of project partners and the Total Maximum Daily Load (TMDL) already established

for the lake. Archaeological and environmental assessments needed for permitting of future watershed work have been completed on state property surrounding the lake.

In the watershed, project partners are implementing a Section 319 (of the Clean Water Act) Watershed Management Plan to address sediment and phosphorus loading to the lake. In the past year, over 500 acres of cover crops have been planted in the watershed, a large grade stabilization structure was installed in the watershed, and over 3,000 feet of terraces were installed.

IDNR Fisheries staff also installed several cedar tree brush piles over the winter to improve fish habitat and fishing success. Brush removal began on state land near the lake where two grade stabilization structures are planned and currently in the design phase and planned for construction in 2016. Additionally, priority areas for shoreline restoration are set to be established in 2016 through partnership with the current watershed coordinator. Finally, fishery numbers look good at Badger Creek Lake with numerous 8-10 inch crappies captured during fall sampling and moderate abundances of largemouth bass recorded during spring electrofishing.

Big Creek Lake (Polk County)

Big Creek State Park/Lake is a major recreational destination for the citizens of Iowa. Over 350,000 visitors travel to Big Creek each year and they annually generate over \$19 million in spending. Improving the lake's water quality through watershed improvements is critical to maintaining and even increasing recreational use of the lake.

Big Creek Lake is currently on the impaired waters list for high levels of bacteria. In addition, nutrient and sediment loading to the lake that result in frequent blue-green algae blooms is of concern. A comprehensive review of the watershed indicates that the watershed annually delivers approximately 6,379 tons of sediment and 8,280 pounds of phosphorus to the lake. We must significantly reduce these numbers to preserve the lake's water quality and extend the lifespan of the lake. Additionally, we must also reduce waste products from humans and animals within the watershed that adversely affect water quality. During the past year, Blue-green algae blooms put Big Creek Lake in the news multiple times. Water quality sample data also revealed high *E. coli* levels at the beach.



Soil Quality Restoration at Big Creek Lake

- A 2007 development grant provided analyses of the Big Creek watershed. In addition, a 2008 gully analysis and 2009 land use analysis established a better understanding of critical areas in the watershed. Watershed assessment identified several gullies with severe erosion on State property.
- The Iowa IDNR Watershed Improvement Section completed a Water Quality Improvement Plan in September 2010 and in March 2010 contracted with the Iowa Department of Agriculture and Land Stewardship to provide Polk SWCD and Boone SWCD with funding to complete a Watershed Management Plan. The EPA approved the Big Creek Watershed Project for \$292,834 over the five-year duration of the project.

Extensive water quality sampling was completed in the tributaries and main lake during 2011. Intensive beach monitoring began in 2013 and has continued over the past several years to better understand where beach bacteria are coming from and how to best manage the beach to minimize risk from pathogens.

- Watershed coordinators working on the Big Creek watershed formed a Big Creek Citizens Advisory Committee has been formed.
- Projects implemented in the watershed include 1720 feet of terraces, 17 acres of grassed waterways, 110,000 sq. ft. of soil quality restoration and 925 acres in cover crops.
- Education efforts in 2015 included numerous programs, such as a female landowner meeting, public presentations, and the 5th annual Big Creek Appreciation Day. Project coordinators taught over 200 4th graders about soil and water conservation during an outdoor classroom.
- Sediment basin construction on the two most severely eroded gullies was completed in 2015 and alternative BMP's will be explored for the other gullies that contribute significant sediment to the lake.

Black Hawk Lake (Sac County)

Blackhawk Lake is the southern most natural lake in Iowa, located in Sac County, Iowa, near the town of Lake View. This 922-acre lake has a watershed of 14,097 acres. Data from the Iowa Department of Natural Resources indicate that the lake currently has an average depth of 5.2 feet. Water clarity was predominantly in the range of 0.5 – 1.5 feet, with phosphorus levels consistently 100-200 parts per billion (ppb). Poor water clarity due to high turbidity and frequent algae blooms due to high phosphorus levels are common.

- Local leadership in cooperation with the DNR and ISU Extension formed a local steering committee (Watershed Action Group). This group includes members of the community and watershed, as well as members from various state and local agencies (e.g. ISU Extension, ISU Agronomist, Sac SWCD, Carroll NRCS, Sac Board of Supervisors, watershed residents/landowners/farmers, Iowa DNR, City of Lake View, Sac NRCS, City of Breda City Clerk, and Carroll SWCD). This committee locally raised \$42,000 to help fund the Diagnostic / Feasibility Study; the goal of the study was to provide restoration alternatives to the DNR and local community; DNR contracted with Iowa State University (ISU) for the D/F study, which they completed in fall of 2010.
- IDALS provided planning assistance to help accurately identify existing problems and issues critical to achieve desired resource management objectives and to help local leaders inventory, assess, and develop strategies to address watershed problems.
- DNR provided funding to the SWCD to take information gathered in the Watershed Assessment, Diagnostic Study and Water Quality Improvement to development of a Watershed Management Plan. This allowed the local group the ability to apply for project implementation dollars for work in the watershed. The SWCD received funding through a DNR 319 Watershed Improvement Implementation Grant. The grant is funding a watershed coordinator for the Black Hawk Lake Project and implementation of BMPs.



Water transparency photos from Black Hawk Lake in 2015. Each photo taken with disk at 0.2m depth. Photos courtesy of Iowa State University Limnology Laboratory. Water clarity at the lake was very good in the spring and early summer.

- The DNR held a public meeting in August 2012 in Lake View to discuss the plans to renovate the fishery at Black Hawk Lake. The major focus of the lake restoration project had been targeting improvements in the watershed. However, internal recycling of nutrients and re-suspension of sediments via rough fish activity was contributing to the water quality issues in Black Hawk Lake. Because of historically low water levels, the DNR implemented a fishery renovation to eradicate rough fish species, help improve water quality, and reclaim the lake in order to establish quality sport fishery.
- DNR implemented a chemical renovation of Black Hawk Lake in November 2012. 3,720 gallons (124 barrels) of rotenone were applied in less than 4 hours on the day of the application. Upon examining the shoreline the following days, just about all of the dead fish that washed to shore were gizzard shad, common carp, bigmouth buffalo, bullhead, and channel catfish. Aside from the channel catfish, there were very few sportfish.

Total Pounds of Fish Tissue Removed from Black Hawk Lake: 354,000; Pounds of Phosphorus Removed via Fish Removal: 8,071; Pounds of Nitrogen Removed via Fish Removal: 37,170)

Status of the Fishery

Following the fishery renovation in 2012 DNR fisheries staff have been aggressively stocking the lake with sport fish (bluegill, walleye, yellow perch, largemouth bass, muskellunge and channel catfish). Although no official creel surveys have been conducted, conversations with anglers have indicated that the bluegill, yellow perch, and channel catfish have been providing great fishing. Some harvestable size walleye have been caught as well. Anglers experienced high catch rates of quality size yellow perch in the fall of 2014. The 2015 fishing season brought great catches of walleye and bluegill. The 12 inch muskies from the initial stocking have now reached lengths of up to 32 inches. Unfortunately, DNR staff observed several



Local angler Bill Hott with a 32 inch muskie caught in 2015 at Town Bay of Black Hawk Lake.

common carp in Black Hawk Lake in 2015. It's uncertain how many are in the lake and only time will tell if our native sport fish population can keep their numbers suppressed.

Outlet Fish Barrier (Black Hawk LPA, Sac County Endowment Grant)

A fish barrier was needed on the outlet of Black Hawk Lake to block undesirable fish species from reentering the system following the fish renovation of 2012. The Black Hawk LPA hired a local fabricator to design, manufacture, and install the barrier and funded the project with their money and a Sac County Endowment Fund Grant. The cost of project was approximately \$21,000. The fish barrier provides a complete enclosure of the spillway for protection under high water events and features 10 rotating gates that can easily be cleaned of debris to allow for unobstructed flow of water.

Denison Beach Shoreline Armoring (Lake Restoration and MFT)

Shoreline armoring was completed in late fall/winter of 2014/2015. Approximately 350 feet of shoreline was armored with native field stone rip rap to prevent further erosion of the already receding shoreline. Since Denison Beach is a popular picnicking and swimming area, a 50 foot wide gap in the shoreline was left open to allow for easy access to the water.

Ice House Point Shoreline Armoring (Wildlife Management Grant)

Local DNR fishery staff was awarded a wildlife diversity grant to use biological armoring to stabilize the shoreline on a portion of Ice House Point. Fescue was removed along an 8 foot wide by 650 foot wide strip of the shoreline and native grasses and forbs were planted. The root systems of these native plants should work to stabilize the shore and provide better infiltration of water into the soil. An educational sign is being developed to highlight this biological



armoring project.

Vegetation Management (Lake Restoration, Local Dollars)

Following the fishery renovation in 2012 and numerous improvements to the watershed, the water clarity in Black Hawk Lake has been significantly improving. Because of the improved water clarity, vegetation has started to grow in the lake basin on scale that has not been seen in decades. While aquatic vegetation is essential to maintaining good water quality and sport fish populations, it can interfere with certain types of aquatic recreation if there is too much vegetation. DNR fisheries wrote a comprehensive aquatic vegetation management plan to address these issues. This plan was reviewed by the Black Hawk Lake Protection Association and the City of Lake View. It was also presented at a Lake View City Council meeting and made available to the public.

The Lake Restoration Program purchased an aquatic vegetation harvester to remove vegetation in select areas in an effort improve recreation. The operation of the harvester is a joint effort between the DNR, the City of Lake View, Sac County, The Lake View Community Club, and the Black Hawk Lake Protection Association. The four entities that have collaborated with the DNR are bearing the cost of the operation and maintenance of the machine, including wages for employees operating it.

Extremely clear water during the 2015 open water season allowed for plant growth around much of Black Hawk Lake. The east basin of the lake and the near shore areas around the lake were filled in with native macrophytes, which consisted mostly of sago pondweed. The vegetation harvester can cover approximately 60 acres a week, but depends largely on weather conditions, operator experience, and density of vegetation. Local DNR fisheries staff will be working with the local community on a plan for applying herbicide to select areas of the lake for the 2016 season. The proposed plan allows for 62.5 acres of the lake (8% of Black Hawk Lake's surface acres) to be treated with herbicide. Herbicide treatments will help to improve boater access and recreational opportunities. Sac County, the City of Lake View, and the Black Hawk Lake Protection Association will be providing the funding for the project and local DNR staff will be providing technical assistance. The herbicide application is estimated to cost \$19,000.



Vegetation harvester working to limit excessive plant growth at Black Hawk Lake.

State Marina Dredging (MFT)

The state marina dredging on Black Hawk Lake is nearing completion. A small barge with an auger and suction device is working to remove and average of three feet of soft sediment from the marina. The project was expected to be completed by use of a backhoe excavator, but the prime contractor chose to utilize a small dredge unit. The spoil is being contained in "bio bags" on shore and the filtered water is returned to the lake. The prime contractor will wait until the soil in the bio bags freezes this winter and will remove it offsite to an approved location. Total cost of the project is \$93,390.00 and was awarded to Healy Excavating. The project is funded by the Marine Fuel Tax program.

Inlet Dredging (Lake Restoration)

The containment site known as the Merehoff Tract is currently being excavated for re-use as a spoil site for future dredging activities in the inlet portion of Black Hawk Lake. A contract was awarded to Spring



Lake Construction for the amount of \$729,532.60. The spillway and water control structure in the containment site is also being replaced. This project is being funded by the Lake Restoration Program.

Panoramic view of Merehoff Tract excavation work.

An archeological survey was completed on the ice during in February of 2015 of the inlet area in order to obtain clearance from the Army Corps of Engineers to conduct hydraulic dredging. The plan is to remove 380,000 to 400,000 cubic yards of soft sediment from the inlet portion of Black Hawk Lake.

Sediment removal of this scale would provide a significant reduction in phosphorus delivery to the main part of Black Hawk Lake. It is expected that dredging will begin in spring of 2016.

Inlet Fish Barrier/Water Control Structure/ Vegetation Management

DNR fisheries and wildlife staff met with Ducks Unlimited to discuss the concept of a new fish barrier and water control structure at the inlet bridge of Black Hawk Lake. Ducks Unlimited completed initial survey work in March 2013. This project would hinder rough fish movement into their prime spawning habitat during high flow events. The current barrier is undersized and fish can find their way around it during high water events. The water control structure would allow managers to dewater the inlet portion of the lake to reestablish aquatic vegetation, and if need be, remove carp. Water quality testing has shown that nutrients leaving the inlet than what is being received indicating the need for better management capabilities in this part of the lake. Funding still needs to be secured for actual construction of the project, but Ducks Unlimited has completed the engineering and design work. It is estimated that this project would cost around \$380,000.



Urban Conservation Practices (SRF, Private Grants)

The city of Lake View has been approved for use of sponsored project funds through the SRF program. The city will be making some much needed upgrades to their waste water treatment facility which will cost around \$400,000. The amount borrowed from the SRF will provide an additional \$40,000 for water quality improvement projects in the watershed of Black Hawk Lake. While the projects have not been finalized, several areas have been identified where the city proposes to install urban conservation practices in the form of rain gardens, retention cells, and bioswales.

The Black Hawk Lake Protection Association received a \$5,000 grant from Flint Hills Resources to be used for conservation practices. The Black Hawk LPA is considering using those funds to assist with the city's efforts funded by the SRF program.

Blue Lake (Monona County)

Blue Lake is a Missouri River oxbow lake located in western Monona County three miles west of Onawa and three miles east of the Missouri River. The lake was an active channel of the Missouri River in 1804 when the Lewis and Clark expedition went through the area. The lake shoreline is now part of Lewis and Clark State Park. Current water quality impairments include aesthetically objectionable conditions caused by excessive algae and low water clarity due to algal and non-algal turbidity. These problems combine to limit the recreational use of the lake.



- DNR completed a Water Quality Improvement Plan for Blue Lake in 2008 and held a public meeting to discuss the findings of the study. DNR held a public meeting in 2009 to present the lake assessment and restoration process and develop a local technical advisory team of conservation agencies and local stakeholders to help guide the project. The group met periodically during the year. Objectives of the project are to reduce nutrient and sediment inputs from the

watershed, reduce re-suspension/recycling of in-lake nutrient and sediments, eliminate rough fish introductions and evaluate lake and water table interactions.

- A public meeting was held in March of 2011 to discuss potential restoration efforts with the community. Lake Restoration contracted with MSA Professional Services to conduct a diagnostic-feasibility study on the lake. Extensive data collection was conducted by local DNR staff throughout 2010. The final report from MSA on the diagnostic-feasibility study was completed in November of 2011. The report proposes that construction of a storm water settling basin, reconstruct water control structures to minimize common carp introductions, dredging and removal of common carp will achieve water quality goals for the lake.
- A Technical Advisory Team meeting was held in 2013 to discuss the report and develop a restoration and implementation plan. The lake aeration system was upgraded in 2013 with a new motor and blower to prevent fish winterkills.

2015 was a busy year for construction around Blue Lake. The DNR Lake Restoration Program hired EA Engineering to design a series of three fish barriers around the lake and modify Nebowa Bay to improve its sediment trapping ability.

Water control / fish barrier structures around the lake were reconstructed with flow-through rock weirs to act as a fish barrier preventing additional rough fish from entering the lake (see picture). In addition, the Nebowa Bay structure also has a first fish screen, the first installed in Iowa, to further prevent fish from entering the lake (shown in the picture).



These flow through rock barriers have been used at other lakes around the state to limit fish movement and will help prevent rough fish from entering the lake should a fishery renovation be completed at Blue Lake. Water control structures were completed in the fall of 2015 and improvement of Nebowa Bay to act as a settling basin above the lake is nearly complete as of December 2015. This phase of work was completed with \$413,773 in lake restoration funds.

Finally, a local stakeholder meeting was held in December of 2015 to discuss the future of the lake and additional lake restoration work needed to improve water quality. The local community plans to talk to

their neighbors and other land owners in the watershed to address watershed and potential septic issues around the lake and discuss future options for in-lake restoration work.

Central Park Lake (Jones County)

Central Park Lake is a 24 acre lake with a 365 acre watershed. In 2012, the DNR worked with Jones CCB to acquire a 77-acre parcel (Pearson Tract) directly above the lake that was in CRP. The purpose of acquisition of the tract was to provide an area for protection and enhancement of Central Park Lake. The CCB will manage the area to improve water quality in Central Park Lake. The Conservation Board's management plan for the area includes the construction of wetlands and ponds to serve as catch basins for runoff, open space for storage of dredge material from the lake, mixed prairie planting throughout the entire area, tree and shrub plantings and walking trails for access to the area and environmental education programs.

Construction of a large western pond (6.75 acres) and a south pond (1.5 acres) on the Pearson Property were completed in 2015 (see picture below). Funding for these projects was completed using dollars from the Fish Habitat Program, Twin River Pheasants Forever, DNR Lake Restoration Program, WIRB, and the Jones County Conservation Board.



New Septic systems (tanks and fields) were installed at the dump station, shower building, campground and rangers residence in 2013. These areas have erosion control devices installed and were covered with straw. Next spring they will be leveled and planted turf grass or native grasses. The lagoon area has been reclaimed (sewage pumped, sludge and 6-12 inches of soil removed). The earthen berms surrounding it were pushed into the lagoon to create a shallow wetland. The goal for 2016 is to move forward with planning between the DNR and JCCB and to begin engineering design for in-lake improvement efforts.

Diamond Lake (Poweshiek County)

Diamond Lake Park is a 660 acre county park with a 98 acre lake that is managed by the Poweshiek County Conservation Board. The fishery is managed by the DNR. Diamond Lake Park is located near the city of Montezuma and features fishing, camping and day use activities. The Poweshiek CCB and the DNR have a history of working together to maintain water quality and provide a fishery at Diamond Lake.



The DNR entered into an agreement is to reimburse the Poweshiek CCB for repair and modification of the existing spillway. The current spillway was in need of repair.

By working with the Poweshiek CCB, project partners were able to modify the spillway with a ten-foot drop, which will eliminate migration of rough fish from Moon Creek into the lake.

This will benefit both the DNR and the CCB in terms of future fish management and negative effect of rough fish on water quality. The spillway modification was completed in 2015 with costs totaling \$160,000. DNR Lake Restoration contributed 80% of the funds for the project, with the county conservation board contributing 20% of the funds needed to complete the spillway modification.

Five Island Lake (Palo Alto County)

Five Island Lake is a 973-acre natural lake located on the north side of the town of Emmetsburg, Iowa in Palo Alto County. In 1989, following years of diminished recreational opportunities and poor water quality conditions due to low lake levels, a group of concerned citizens formed the Five Island Lake Board. They established two major goals for the project: Increase the lake water depth; and, improve the lake water quality. Goals of the 1994 diagnostic feasibility study included goals for dredging and shoreline stabilization. During the 90's, the Lake Board has stabilized almost 10.5 miles of lake shoreline, dredged over 7 million cubic yards of silt, and has worked in the watershed to reduce nutrients and sediment from entering the lake. Funding for this project since 2000 has required a combination of 1:1 state and local matching grants.

Year	Cubic Yards
1991-1993	1,390,000
1994-1999	3,028,000
2002-2011	1,926,296
2013	205,221
2014	250,968
2015	208,912
Total	7,009,397

The current plan is to continue dredging in the spring of 2016 to utilize the remaining bond funds available to the city and fill the current Stillman Spoil Site to capacity. The LRP is working to initiate additional work in watershed to protect Five Island Lake from future sedimentation. No additional LRP funds are required to complete the 2016 dredging; however, the DNR will look at opportunities to learn more about continued turbidity and influence of rough fish on the water quality of Five Island Lake.

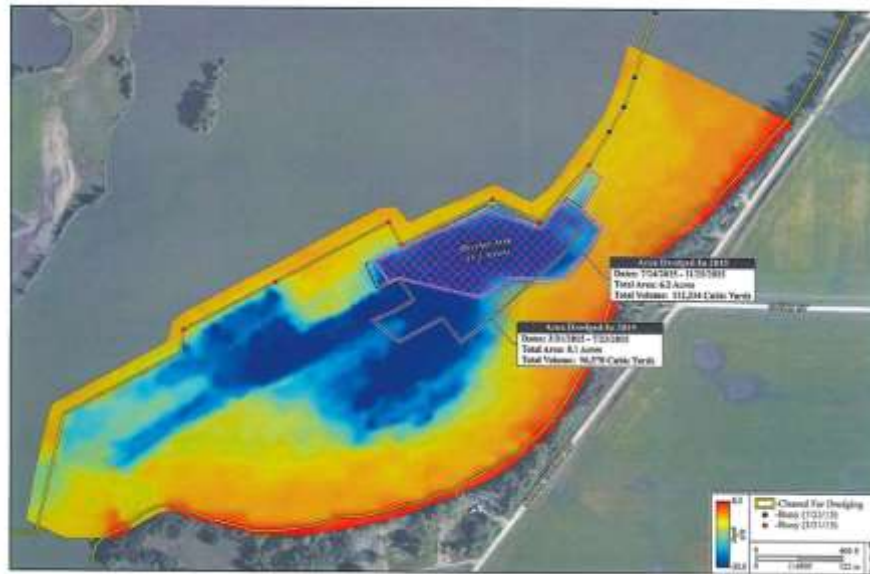


Figure 1. Water depths on November 25, 2015.

Region dredged during the 2015 open water season. Bear Creek Archeology survey estimated that as of November 2014 the City had dredged 208,912 cubic yards from a 14.3 acre area.

2006 TMDL: Impaired water for algae and turbidity

- Large source of turbidity is from internal re-suspension of sediment. A TP load reduction of 17% is needed to achieve water quality goals and protect the designated uses.
- TMDL supported that dredging was a critical component to improving and maintaining water quality improvements. However, partners recognize that water quality still does not meet expectations and a plan needs to be developed to address the watershed and any other in-lake issues.

Recent Activities

- The Palo Alto SWCD received an IDALS-DSC development grant for assessment of Five Island Lake and its watershed. This was completed in 2007.
- Summer 2008 tour with local stakeholders and the DNR Lake Restoration Program reviewed progress and the need for continued watershed work to compliment local dredging efforts.
- On November 2011, the DNR met w/ the City of Emmetsburg, Palo Alto SWCD, Palo Alto CCB, IDALS and members of the Lake Board to discuss status of project and potential future work.
- In March of 2015, DNR met with the Five Island Lake Board and other community members to discuss the future of the restoration project and the need to develop a watershed project as the dredging portion of the project nears completion.
- In addition to wrapping up the dredging portion of their project, the community is evaluating the need for additional work in the watershed and in-lake management strategies to achieve the desired water quality goals. The Lake Program will be working with the community to obtain any additional information needed to develop water quality improvement plans and in order to implement practices.

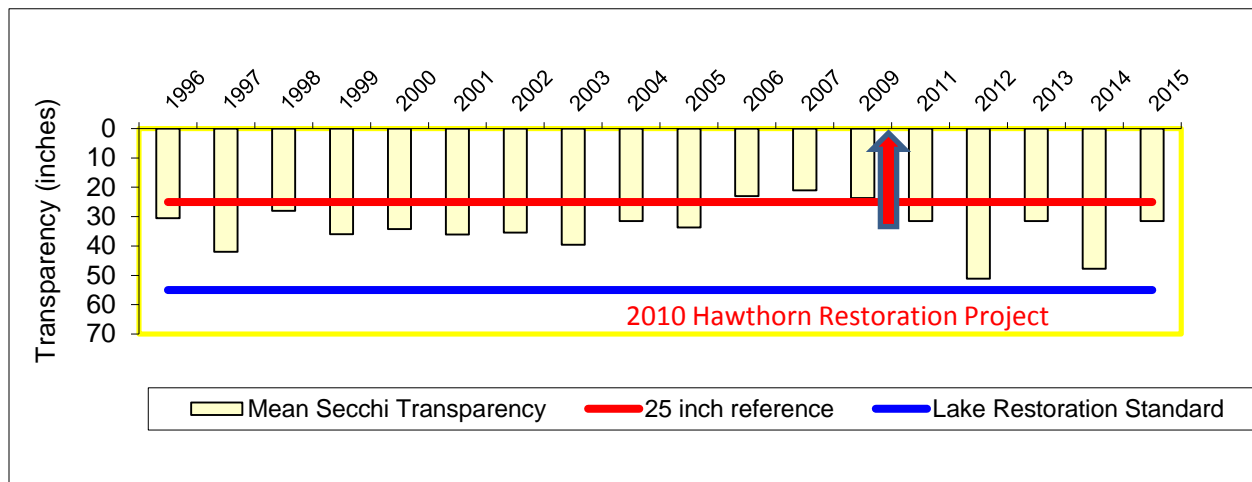
Hawthorn Lake (Mahaska County)

The Mahaska County SWCD applied for, received a watershed assessment grant from IDALS, and completed the assessment during the winter of 2007. They then held a kick-off meeting in May of 2010, with 34 landowners, stakeholders, staff, commissioners, news media, etc. in attendance. Partners discussed shoreline work, structures on public property, signage, private land progress, and reviewed goals. The Mahaska SWCD applied for and received a WIRB grant of \$360,900 toward Lake Restoration activities. In addition, a total of \$208,618 in Publicly Owned Lakes (POL) funds has been available to the project. Lake Restoration Program utilized funds of \$450,000 for in-lake shoreline stabilization, deepening, and watershed improvement on state lands.

- To-date landowners have completed a grade stabilization structure with sediment loading reduction of 157 (tons/year). 3,238' of terraces on private property have been installed reducing sediment loading by 104 (t/y), and 2,109' of waterways reducing sediment loading by 32 (t/y) on private property.
- DNR awarded a \$384,854 contract to Cornerstone Excavating, Inc. of Washington Iowa for in-lake restoration work at Hawthorn Lake (\$147,824 Fish and Wildlife Habitat Funds, \$132,033 Lake Restoration Program, \$100,000 Mahaska County SWCD WIRB grant). The project, completed April 2011, consists of the placement of in-lake habitat, shoreline armoring and deepening, and jetty construction/repair.

The DNR has designed eight sediment control ponds for watershed improvement on public and private ground. Phase I: Five of the eight structures on public property were let for bid on January 19, 2012 and are now completed. The last structures will be completed in spring 2016. A Lake Restoration / Wildlife Bureau joint purchase of an additional 40 acres in the northwest portion of the watershed will be treated to improve water quality.

Water quality benefits from restoration efforts have already been observed. The figure below demonstrates water quality before and after the 2010 lake restoration project. Trends in secchi disk transparency suggest that water quality has improved in the years following the completed restoration efforts. The additional treatments planned for 2016 should further improve water clarity.



The Hawthorn Lake fishery has redeveloped quickly following completion of the 2010 restoration project. Largemouth bass abundance and quality are excellent. Three of every four tournament permits issued from the Rathbun Fish Management District for 2016, thus far, have been issued for Hawthorn Lake. The level of attention is so great that KCRG TV in Cedar Rapids broadcast a story regarding the success of the lake restoration program in October, 2015.

The DNR Lake Restoration Program, DNR Wildlife Bureau and Mahaska County Conservation Board worked cooperatively to eradicate early secondary succession woody vegetation from targeted areas on the Hawthorn Wildlife area. Lake Restoration provided up to \$15,000 for removal of these trees, which will allow for the stabilization and restoration of native grasses, providing overall better watershed protection while improving wildlife habitat.

Hickory Grove Lake (Story County)

The Hickory Grove Watershed is located in Story County, Iowa. It has a drainage area of 4,026 acres and landuse distribution of 84.7% row crop, 9.8% grass, 1.6% forest, 2.2% water, 0.9% barren and 0.7% artificial. Iowans consider Hickory Grove Lake an important recreational resource; however, the lake is experiencing event driven water quality problems that negatively affect this resource. In general, the Hickory Grove watershed has few elevation changes and much of the agricultural land is under tile drainage management. Storm related surface runoff has led to gully erosion, debris and nitrogen spikes immediately after these events.

The east end of the lake is now sediment filled, limiting boat access. The fishery is healthy; however, carp have destroyed most vegetation and IDNR is considering a lake fishery renovation. The lake has a designated use of primary contact recreation and is listed on the 2008 303(d) Impaired Waters Listing for elevated bacteria concentrations.

- Watershed Technical Advisory Team met from the summer of 2008 - 2012 to discuss water quality improvement efforts at the lake. The NRCS received Development grant was in 2008 to determine critical areas in the watershed with significant quantities of sediment and nutrient delivery to the lake and completed a land use assessment in 2009.
- The Story SWCD has listed the Hickory Grove Lake Watershed as an Environmental Quality Incentives Program (EQIP) priority watershed. The EQIP is a voluntary program that provides financial and technical assistance to agricultural producers to help plan and implement conservation practices.
- Spring 2011, ISU received an IDNR Planning Grant for development of a Watershed Management Plan for Hickory Grove Lake. ISU has finished the Watershed Management Plan, which outlined recommended improvement strategies for as bacteria levels and goose control at the beach, lake draw-down, sediment removal and fishery renovation over the next three years.



The County received a WIRB grant in 2014 to use with Lake Restoration funding and relocate livestock from a tributary stream and reduce erosion on a watershed landowner's property. Pictures from this project are shown above (before and after).

- Story County staff stabilized approximately 450 feet of shoreline with rip rap along the southwest shoreline and the emergency spillway from the ice in 2013/2014. A more recent evaluation of the lake shoreline was completed in the fall of 2014 and additional shoreline improvements are slated for 2016.
- The County has provided a cost-share program for watershed residents in need of updated septic systems. To date, seven systems have been installed and the remaining two systems are scheduled for installation in spring, 2016.
- Story County is working with the NRCS to reevaluate the in-park gully erosion to determine if sediment control structures are necessary to reduce sediment loading to the lake. Story County staff continues to work on timber stand improvement and oak savanna restoration and clearing of invasive species from around lake using mechanical removal and prescribed burns.

Iowa Great Lakes (Dickinson County)

The DNR recognize that the Iowa Great Lakes (IGL) are a significant public resource and continue to support efforts to maintain and improve lake water quality in the region. The IGL are major recreational lakes for Iowa residents and visitors from adjacent states.

Summary of DNR Lake Restoration Program funded projects at the Iowa Great Lakes (2010 – 2015)

<i>Project Description</i>	<i>Project Cost</i>	<i>Lake Restoration Program Cost-share</i>
Center Lake Urban BMPs	\$469,999	\$47,944
Watershed Conservation Practices	\$308,789	\$160,000
Okoboji View - Beddell Tract	\$578,000	\$250,000
Okoboji View – Chapman-Sebby/Peace Tract	\$680,000	\$25,000
Okoboji View Restoration	\$578,960	\$201,688
Marble/Hottes Restoration	\$450,000	\$350,000
Total Cost	\$3,065,748	\$1,034,632 (34%)

The DNR LRP partnered with the Department of Agriculture and Land Stewardship to implement conservation strategies, in cooperation with the local County Soil and Water Conservation District, identified in the Iowa Great Lakes Targeted Watershed Project. Funding plan for the overall project is provided in the below table.

Project Description	LRP Funding	Local Match*	State Match**	Total
CRP Incentives			\$5,000	\$5,000
Sediment Basins		\$10,000	\$25,000	\$35,000
Low Impact Development (LID) Practices		\$30,000	\$25,000	\$55,000
Other		\$2,000	\$13,000	\$15,000
Water Monitoring	\$5,000	\$12,000	\$3,000	\$20,000
Tile Intake Treatment	\$15,000	\$25,000	\$15,000	\$55,000
Watershed Coordinator	\$15,000	\$5,000	\$45,000	\$65,000
Total	\$35,000	\$84,000	\$131,000	\$250,000

Projects in Process to be bid let for construction in the spring for 2016 construction

EA Engineering is under contract at a cost of \$63,200 to design shoreline improvement, fish barriers and wetland enhancement at Center Lake. Construction will take place in 2016.

Project Description	Lake Restoration Program Funding	Local Match*	State Match**	Total
Center Lake Shoreline	\$200,000	\$30,000	\$50,000	\$280,000
Center Lake Wetland	\$110,000	\$25,000	\$10,000	\$145,000
Total	\$310,000	\$55,000	\$60,000	\$425,000

*Local match includes: Landowner, Water Quality Commission, Center Lake Improvement and Protection Association, OF-YIP, and the Okoboji Foundation.

**State Match includes: IDALS – Watershed Improvement Review Board, Iowa Watershed Protection Fund and DNR 319 Program.

Work in the Iowa Great Lakes Watershed

The DNR is working with the Department of Agriculture and Land Stewardship (IDALS) to implement conservation strategies, in cooperation with the local County Soil and Water Conservation District. Urban Practices

- Improved storm water intakes for filtering storm water before it reaches the lake and improve lake shoreline to prevent further erosion
- Constructed several bio-cells as a water control structure to filter or settle sediment from water draining to East Okoboji Lake, West Okoboji Lake and Center Lake
- Constructed two subdivision bio-swales which filter storm water runoff

Wetland Restoration

- Implemented a wetland and prairie restoration on the North Shore of West Okoboji that reduced the amount of sediment reaching the lake from 80 acres
- Enhanced a wetland to intercept 19 acres of agricultural runoff entering East Okoboji Lake

Okoboji View Watershed Project / Sandpiper Cove – West Okoboji Lake

For years, this 1,700-acre portion of the West Okoboji Lake watershed has been considered an area of primary concern for maintaining water quality in West Okoboji Lake. It drains into Sandpiper Cove on West Okoboji Lake, an area known for chronic blue-green algae problems and flooding. In 2008, a watershed assessment was completed for the Iowa Great Lakes watershed under an EPA 319 grant and this subwatershed was identified as a high priority for restoration.

Acquisition of property within the West Okoboji watershed has allowed for this opportunity for wetland restoration. For example, in 2010 the Natural Resource Commission approved the acquisition of a 90-acre tract of land offered by the Iowa Natural Heritage Foundation for \$478,000 (\$250K LRP, \$150K NAWCA and \$78K REAP Open Spaces). The tract was appraised at \$578,000 (INHF received a \$100,000 grant from the Dickinson County Water Quality Commission). This is part of a larger 230-acre tract acquired by the INHF in March 2010. After restoration, the land now contains 54 acres of native prairie plantings and 35 acres of restored wetlands. Also in 2010, the INHF acquired a 120-acre parcel and facilitated transfer to public ownership. The Chapman-Sebby/Peace tract was another critical acquisition



toward a successful improvement to the Okoboji View drainage. The 120-acre tract was purchased for \$680,000 by INHF using the following funding sources (USFWS Waterfowl Production Area Program - \$448,000; North American Wetlands Conservation Act grant program - \$82,000; Dickinson County Water Quality Commission - \$75,000; INHF - \$50,000 and the Lake Restoration Program - \$25,000.

Map showing the Okoboji View Watershed, public land boundary, and proposed wetland locations.

Pre-project modeling estimated sediment deliver from portions of this watershed at 480 tons for a two-inch rainfall. Project partners implemented a \$554,793 initiative to address sediment delivery/nutrient loads from this sub-watershed of the Iowa Great Lakes. Approximately 75 acres of wetlands have been constructed or restored on 350 acres of public land and a private golf course. The DNR constructed and restored wetlands on the project site to be capable of storing up to 100 acres of water during storm events. The project was tested immediately following completion as an extreme rain event hit the area in June 2014. The wetlands and water level control structures functioned well preventing downstream flooding on the West Okoboji Lake shoreline and stopping countless tons of sediment from entering the lake.

The development of prairie restoration efforts on this new property were continued in 2015. The reduction in the amount of sediment and surface runoff was noted by a number of community members.

East and West Hottes Lake/Marble Lake/Grovers Lake Complex (Dickinson County)

Located within the Kettleson Hogsback wildlife complex in northern Dickinson County, these 4 basins are of extreme importance to fish and wildlife as well as water quality in the Iowa Great Lakes. Marble Lake (160 acres) and West Hottes (225 acres) drain to Big Spirit Lake. In fact, nearly 20% of the water entering Big Spirit Lake comes through these lakes. Historically, these basins contained a diversity of high quality aquatic plants that supported a wide array of sport fish, waterfowl,

water birds, furbearers, reptiles, amphibians, and other wildlife. Excessive numbers of carp and chronic high water levels have resulted in the loss of many of these plants and the animals that depend on them.



A series of wetland basins were constructed and restored near the bottom of the 1,700 acre watershed.

The Okoboji View Golf Course was an important partner in this project. The golf course lies just downstream from the project wetland construction and enhancement on this private property was critical in reaching the overall project goals.

A number of partners planned and implemented this \$450,000 restoration project for Marble and



Nearly completed pumping station on Marble Lake

Hottes Lakes (\$350,000 from LRP). The Big Spirit Lake Association, DNR, DU, Dickinson County, and others provided funding and technical guidance to develop a comprehensive feasibility study to identify ways to return ecological health to this critical habitat. Final design incorporated water control structures and pumps that allowed for the temporary draining of the basins and fish barriers that allow for the passage of game fish but preclude the passage of carp.

In May 2014, the Spirit Lake Protective Association hosted a well-attended/positive public meeting prior to the beginning of construction. All phases of construction were completed in 2015 and the new infrastructure allowed both lakes to be drawn down through 2015. Water levels have been managed to maximize water quality and aquatic plant benefits. Both lakes will be maintained below pool level during the winter of 2015/2016 to eliminate common carp. In addition, wetlands within the watershed will be renovated during this final winter of drawdown to remove invasive fish. High diversity stockings will occur on Marble Lake in 2016 and current plans show both lakes will be brought back to normal pool level in 2016.



Before (2014) and after (2015) project photos of West Hottes Lake.

Asian Carp in the Iowa Great Lakes

Barrier Cost

Item	Bid	Cost
Engineering and Construction Oversight	\$118,000	\$118,000
Materials and Construction	\$843,000	\$920,000
Total	\$961,000	\$1,038,000

Fundraising

Source	Funds
Local partners and private donations	\$400,000
Iowa DNR	\$377,000
Minnesota DNR	\$261,000
Total	\$1,038,000

The Iowa Great Lakes electric fish barrier went into formal operation in May 2013. This barrier will protect the Iowa Great Lakes from future invasions of bighead and silver carp. The barrier was operated for short periods of time in 2014 and 2015. Fisheries staff was heavily involved during construction and make regular visits to the barrier during weekend and weekday hours throughout any operation of the barrier to provide safety reminders, communicate, and educate the public about the barrier. The barrier will protect of the Iowa Great Lakes from future introduction of invasive fish species while recent sampling indicates the existing population, which entered the lakes during

flooding in 2013, exists only in low numbers and will not reproduce.

Center Lake (Dickinson County)

The Iowa DNR Lake Restoration Program supported the Dickinson SWCD watershed Improvement Review Board (WIRB) Center Lake Low Impact Development \$469,999 grant for the installation of urban conservation practices that will be installed in the Center Lake Watershed in 2014. These urban conservation practices, involving bio-retention cells, pervious paving systems, and other Low Impact Development Practices resulted in beneficial impact to the water quality of Center Lake. The Lake Restoration Program contributed an estimated \$47,944 dollars over the life of the project. Remaining funding is EPA 319 Grant - \$374,111 and City of Spirit Lake - \$47,944.



Projects completed in 2014/2015

A series of strategically placed urban low impact development practices were constructed in 2014

in the Center Lake watershed. These practices will slow rainwater, sediment and nutrients from entering the extensive stormwater system that drains to Center Lake.

Two rock common carp barriers were engineered and constructed on the south side of Center Lake in 2015. These barriers will prevent common carp from entering two private wetlands draining into Center Lake. Not only will preventing common carp access to these wetlands help to manage common carp populations by eliminating access to spawning areas, elimination of carp will improve wetland health and improve habitat.

Rock Barrier being installed around a culvert draining from a large private wetland on the south side of Center Lake.

In 2015, an engineering contract was awarded to a private engineering firm to assist in the planning and design of a multifaceted project to improve water quality in Center Lake. Other partners in this project are the Okoboji Foundation, Dickinson County Water Quality Commission, Center Lake Improvement and Protection Association, and WIRB providing \$140,000 towards this project.

Rock Barriers



Project components

- *Center Lake shoreline restoration* – 800 ft. of severe shoreline erosion on public land has been identified and engineering solutions for this problem are being explored.
- *Common carp barrier* – A barrier will be engineered between the Center Lake and Jemmerson Slough Complex and West Okoboji Lake. This barrier will prevent common carp from migrating upstream from West Okoboji Lake into the lakes and wetlands in this complex.
- *Wetland enhancement* – An existing wetland near West Okoboji Lake will be enhanced to further treat outflow from Center Lake and the Jemmerson Slough Complex.

Kent Park Lake (Johnson County)

Kent Park Lake is a 27 acre man-made lake in Johnson County that serves as a popular recreation destination for the surrounding communities. The lake has a 25 to one watershed to lake area ratio, and much of the land in the watershed is forested or grassland. The park is currently operated and maintained by the Johnson County Conservation Board (JCCB). Planning meetings began in early 2015 to develop a watershed plan for the lake and discuss future potential in-lake work to improve degrading water quality conditions. Other activities include:

- Johnson CCB staff continues to monitor 9 different parameters in 16 locations within the lake watershed between March and October 2015.

- U of I Graduate Student Reid Simmers monitored bacteria concentrations 2-3 days/week, between April and October 2015, in multiple locations throughout the lake's watershed.
- The USGS collected sediment samples from multiple locations within the lake and measured the P concentration in 6" depth intervals of the lake sediment.
- The JCCB sponsored a meeting of the Technical Advisory Committee Members, reviewed all collected data and finalized goals and objectives for the Lake Restoration effort.
- Lake Watershed Assessment and Management Plan were completed.
- The JCCB, in coordination with the IDNR Fisheries and Lake Restoration Program, distributed an RFP and received 6 proposals for engineering and design services related to constructing 6 new catch basins, dredging 6 existing catch basins and dredging the main lake. The contract was awarded to Stanley Consultants with a bid of \$1,718,600 for Phase 1 with engineering costs of \$224,000 and a Phase 2 bid of \$1,336,400 with engineering costs of \$184,000. This project includes a 20% cost share with the Johnson County Conservation Board.
- The JCCB scheduled a public information meeting for the lake restoration effort on January 7th, 2016.

Lacey Keosauqua State Park Lake (Van Buren County)

Lake Restoration, Fisheries, and IDALS staff met in the summer of 2014 to discuss watershed improvement in the Lacey Keosauqua watershed. Previous efforts have identified watershed issues, primarily gullies and their associated head cuts, as the primary threats to Lacey Keosauqua water quality. A watershed assessment was completed in 2015 and potential watershed treatments are being considered for implementation.

Lake Geode (Henry County)

Lake Geode, located in Henry and Des Moines Counties, is a 174-acre lake encompassed by a 1,640-acre state park. The entire Lake Geode Watershed consists of approximately 10,327 acres. The watershed encompasses drainage from Cedar Creek and the lake outlets to the Skunk River. This scenic lake was constructed in 1950 and has excellent fishing. DNR estimates that Lake Geode State Park attracts approximately 180,000 annual visitors who camp, hike, fish, and boat within the park.

The goals of the Lake Geode Watershed Project are to reduce bacteria, sediment and phosphorus from loading into Lake Geode. Project partners plan to achieve these goals through a combination of best management practices that will target identified source contributors from state and private land. The following agencies are working in partnership to achieve this goal, Iowa Department of Natural Resources (DNR), Iowa Department of Agriculture and Land Stewardship – Division of Soil Conservation (IDALS-DSC), Natural Resources Conservation Service (NRCS), Henry Soil and Water Conservation District and Des Moines Soil and Water Conservation District.

Goal 1: Address bacteria impairment of Lake Geode in an effort to remove it from the 303(d) list

Goal 2: Reduce total phosphorus and sediment delivery from agricultural and non-agricultural sources by 6,351 lbs./year and 2,499 tons/year, respectively.

The Natural Resources Conservation Service, Iowa Department of Agriculture and Land Stewardship and the Iowa Department of Natural Resources have been working together to install Best Management Practices (BMP's) on state property. The Lake Geode Watershed Coordinator continues to make

progress in the watershed. For example, terrace projects have been completed and septic systems are being investigated in terms of leakage/upgrading.

In 2012, the DNR completed five grade stabilization structures and four sediment ponds within the park boundaries. Seven additional structures were installed in 2014 and 2015 around the park; two of which were within the park boundary.

Site #9 along the north boundary of the park.



A shoreline riprap project was recently undertaken and completed near the Lake Geode main boat ramp. Both Natural Resources Conservation Service (NRCS) and Iowa Department of Natural Resources (IDNR) staff noticed that, in recent years, the shoreline surrounding this key infrastructure was showing considerable signs of erosion due to wind and wave action as well as sustained foot traffic by recreational users. Portions of the affected shoreline were lightly armored in the past, but constant battering from waves had resulted in sloughing which rendered much of the previous riprap ineffective. Wind and wave erosion can lead to lakeshore instability.

Unstable banks eventually slough resulting in loss of depth and decreased water clarity given the soil can be suspended in the water column. Nutrients once adhered to soil are now available for uptake by aquatic plants leading to algal blooms.

Buford Dozing and Excavating, Bonaparte, IA was awarded the contract for nearly \$100,000 to armor almost 1,000 feet of shoreline with 24-inch diameter rock (commonly used for riprap protection). Placement of the riprap was unique in that the rock was loaded on a barge and transported to areas of concern. This method led to minimal damage to the landscape and trees as opposed to if the project would have completed from shore. The cost of the riprap project was paid for using State Marine Fuel Tax and Lake Restoration funds.

Additional pond structures within the watershed to prevent nutrients and sediment from entering Lake Geode were constructed in 2015.



Five of the seven structures recently installed were built on the park boundary line and involved multiple landowners. The photo (right) shows



one of those structures. The goal for 2016 is to move forward with planning between the DNR and JCCB and to begin engineering design for in-lake improvement efforts.

Fish were also stocked in ponds constructed within the Geode State Park boundary by the DNR. Game fish were introduced to increase angling opportunities at the lake.

In addition to watershed improvements, a number of projects are underway in the park to improve recreational opportunities and provide better wildlife habitat within the park. Wood duck boxes (see photo below) were installed near the recently constructed ponds. Each of the wood duck boxes were donated by citizens from the community. New trail construction is being planned to allow for better access to the recently constructed ponds in the park. Finally, multiple practices to help deter geese from living near the beach and contributing to beach bacteria problems (see photo below). Practices that have been used to date include wood-lathe snow fencing, pyrotechnics, and Mylar tape.



Lake Keomah (Mahaska County)

DNR held a public meeting in fall of 2009 to gauge local support for restoration activities at Lake Keomah. The Mahaska County Soil and Water Conservation District applied for, but did not receive, a watershed assessment grant to evaluate the status of sheet and rill and gully erosion within the watershed in 2008. They completed a sheet and rill assessment in 1991; however, it did not include any assessment in the State Park or in Keomah Village.

Current activities center on the creation of a “Friends” group for the State Park, laying the groundwork for local support and participation in future restoration activities. DNR Watershed Improvement Section completed a Water Quality Improvement Plan in 2012 to address non-support of designated recreational use due to impairment issues of algae and pH. DNR Lake Restoration Program has identified Lake Keomah as one of our 35 priority lakes for restoration. Currently, Lake Restoration and other Fisheries Bureau staff are communicating with the Mahaska Soil and Water Conservation District to in an effort to perform a watershed assessment of sheet, rill, and gully erosion on private and state-owned property comprising the Lake Keomah watershed.

Lake Keomah is a high priority lake for restoration, according to the Iowa Lakes Study. Lake Restoration, IDALS, and Rathbun Fish Management met on-site in 2014 to discuss steps for lake restoration at this 79 acre impoundment. An initial list of objectives was completed. IDALS will approach the Mahaska Soil and Water Conservation District, to determine interest in completing an updated watershed assessment. A new watershed coordinator is to begin in January, 2016, and will be responsible for completing an assessment. Lake Restoration will fund the study. The last assessment was completed in 1991. Keomah's TMDL's for sedimentation and nutrient impairments have been completed, but underlying causes have not been addressed since construction of one large basin on the western arm in 1996.

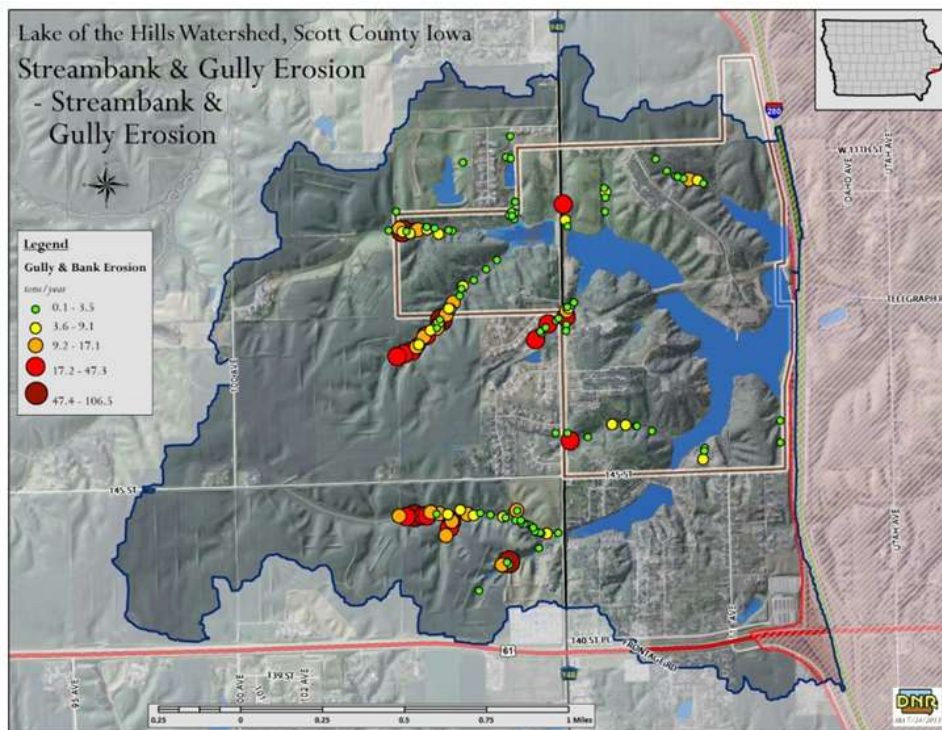
Potential restoration activities discussed included: dredge removal of 100,000 cubic yards of sediment, improvement of upper boat ramp, improvement of trail on Keomah Village side on the DNR setback, with improved marking of DNR access to the Keomah Village road, in conjunction with parking improvements for jetty access on the eastern side of the lake, construction of fishing jetties on the western side of the east arm, improved access from trains for the western arm of the lake, fish habitat improvements, timber clearing on and near the dam, construction of basins and other BMP's as indicated by the watershed assessment. Potential funding sources include POL and Lake Restoration. Additional potential treatments include removal of grass carp with low-dosage rotenone treatment and increased pool elevation of the large eastern basin on State property. The overall project is anticipated to cost approximately \$1.5 million.

Lake of the Hills (Scott County)

Lake of the Hills (LOH) is located near Davenport, Iowa. The main basin of the lake is 54 acres with an approximately 2,000-acre watershed. LOH is the largest lake in a complex of five (Bluegrass Lake, Railroad Lake, Caynada Lake, and Lambach Lake) that make up the West Lakes. The other three lakes serve as sediment retention ponds but offer recreational fishing.

Lake of the Hills is listed as impaired because of low water clarity due to algae blooms and has both gizzard shad and grass carp, which promote turbid water conditions. There has been strong interest from the partnering agencies to develop a plan for lake restoration and a great deal of progress has been made on initiating this effort. For example, the Scott CCB entered into an agreement with Pathfinders Resource Conservation and Development to assist in the development of a watershed management plan and grant writing. NRCS began contacting landowners about the possibility of implementing projects to reduce sediment delivery. There is potential for work (e.g., rain gardens, fertilizer application) in housing developments adjacent to the lake complex as well.

Most of the work done at Lake of the Hills thus far has been planning and developing partnerships (e.g., with IDALS, NRCS, CCB, SWCD). A shoreline assessment was completed on both Lake of the Hills and Railroad Lake; this assessment was aimed at determining the need for riprap protection in shoreline areas subject to erosion. Meeting discussions have centered on the possible watershed practices that could be implemented to help improve lake water quality.



Currently, Bluegrass, Railroad, and Lambach Lakes all serve as sediment retention basins for Lake of the Hills.

Bluegrass Lake has nearly filled with sediment, reducing its capacity to trap sediment and prevent it from entering Lake of the Hills. Railroad Lake also shows signs of increased sedimentation, especially at the upper end of the lake.

Sediment resuspension via wind and wave action contributes to poor water quality in the small lakes surrounding Lake of the Hills.

Lambach Lake has also been subject to some sedimentation, but less so than its sister lakes. Sediment removal from these smaller lakes is needed to regain holding capacity and deepen shoreline areas complex-wide. Addressing gully erosion in the watershed is also a project priority. Finally, the West Lake System is infested with gizzard shad and common carp; thus, the long-term plan would include renovating the fishery. The Scott CCB has collaborated with Pathfinders RCD to develop a watershed management plan, which is being finalized as of December 2015.

Project partners met in the fall of 2015 to discuss next steps for the lake. Following the completion of the watershed management plan, the group plans to seek out funding to begin watershed work. DNR's Watershed Improvement Section is planning to write a TMDL, or Water Quality Improvement Plan, in 2016 to be used in conjunction with the watershed management plan and guide future watershed and in-lake work. The project partners plan to meet in early 2016 to discuss water monitoring options prior to the development of the TMDL.

Lake Manawa (Pottawattamie County)

Lake Manawa is a 715-acre oxbow lake with a watershed to lake area ratio of 4:1. Mosquito Creek supplies additional water to the lake. Past lake dredging work in the 1960s deepened significant portions of the lake. However, maximum lake depth does not exceed 13 feet with large expanses of 6 to 7 feet deep water. The Iowa Department of Transportation approached the DNR to explore the possibility of dredging the lake for sand to use for highway construction. However, there is concern about whether they can remove sand materials from Lake Manawa while still maintaining the hydraulic seal between the lake and the fluctuating Missouri River.

- The Iowa DOT and DNR have met periodically since 2007 to discuss opportunities to obtain highway building materials from Lake Manawa sediments.

- The DNR hired Tetra Tech to conduct a diagnostic and feasibility study and review the option of dredging as a potential lake restoration activity. Tetra Tech also completed a Jurisdictional Wetland Delineation for Lake Manawa Pilot Dredge Spoil Site and finalized a dredging plan that will reduce the risk involved both in providing the materials to the specifications required for any end user and in the ability to control additional seepage from areas along the lake bottom. In advance of dredging, Tetra Tech has prepared a Phase I Archaeological Investigation as part of the Diagnostic and Feasibility Study of Lake Manawa.
- One of the primary goals of Lake Manawa's restoration would include an increase in mean depth from the current 6.1 feet to approximately 8.0 to 10.0 feet and an increase in water clarity to 4.5 feet, at least 50% of the time as measured from April through September. Achieving a mean depth of approximately 9.0 feet will require removal of 3.3 million cubic yards of material. A secondary goal will be to obtain deeper sand that may then be used for Iowa Department of Transportation (IDOT) road projects and/or other local construction activities.
- DNR hired FYRA Engineering in 2014 to provide design/oversight services related to dredging Lake Manawa and store the material on state land adjacent to the lake.



Lake Manawa meeting draws a crowd in Council Bluffs. FYRA Engineering and Lake Restoration visits with Nonpareil reporter.

- JF Brennon Co. is currently under contract to dredge 500,000 CY of sand from Lake Manawa in 2016. Mobilization of equipment is expected in March. The planned duration of the project is 4 months. Their bid to dredge and stockpile material was \$4.2 million, lower than the \$5.2 million DNR Engineering estimate.
- The DNR will attempt to market the dredge material (sand) after this project is complete. FYRA Engineering has identified several potential buyers for this material including IDOT road project contractors and levee districts.

Lake Manawa plan to dredge 500,000 cubic yards of sand in 2016.



The DNR continues to meet with groups such as the “Friends of Lake Manawa” to solicit support and to assist in moving the lake/watershed restoration project along. A series of public meetings were held in 2014 and 2015.

Lake Miami (Monroe County)

Lake Miami is a 122-acre impoundment located on the 776 Miami Wildlife Area, approximately 6 miles northwest of Albia, in Monroe County. The lake, constructed in 1967, is owned by the Iowa Department of Natural Resources. The area is cooperatively managed by the Iowa DNR and through a 28-E agreement by the Monroe County Conservation Board, which operates campground, cabin rental, and a nature center facility on 89 additional acres of adjacent County Park. The lake and park provide facilities for boating, fishing, camping, picnicking, and hiking. Park use, as determined in the recent Center for Agricultural and Rural Development (CARD) study is estimated at approximately 43,000 visits per year. However, angling and camping usage of the area declined in the early 2000's, as did water quality and angling quality.

The Iowa Department of Natural Resources (DNR) has identified Lake Miami as impaired and has placed it on the Clean Water Act Section 303(d) list of impaired waters in the state. The identified pollutant is siltation from agricultural non-point sources (NPS) impairing aquatic life in the lake. In addition, Lake Miami is one of the significant publically owned lakes in Iowa as identified by the Iowa Department of Natural Resources Lake Restoration Program. From 1971 to 1991 mean secchi disk readings exceeded 25

inches eight out of 10 times (80%); since that time mean secchi readings have exceeded 25 inches only four out of 10 times (40%). These data indicate a substantial decline in secchi transparencies in this time. Possible reasons for the decline in water quality include turbidity from sediment, nutrient delivery from sheet/rill and gully erosion in the watershed, shoreline erosion due to wind and wave action and the re-suspension of these bottom sediments and their associated nutrients from wave action, and re-suspension of sediments by rooting action of Common Carp.

The Monroe County Soil Conservation District applied for and was awarded \$17,000 (\$15,000 from Division of Soil Conservation with \$2,000 from Iowa Lake Restoration funding) for an updated watershed assessment of the Lake Miami Watershed. This assessment was completed fall 2012. The District applied for \$250,000 in WIRB funding for the construction of up to 14 structures on State property to reduce gully erosion. Funding for \$150,000 was awarded for this project under WIRB. As a result, the project was reevaluated and the total number of structures to be constructed was reduced to six. In addition, Lake Restoration will augment the awarded funding and will fund design and contracting of these structures to ensure project completion. These structures will be constructed in 2016.

An assessment of the fishery indicated that common carp were present in excess of 400 lbs./acre while gamefish biomass was minimal. Angling quality has decline dramatically in recent years, mirroring changes in water quality. The fish population at Miami was renovated in late October 2013. Common carp and all other fishes were removed from the lake. The lake was restocked in the spring of 2015. Largemouth bass up to 20 inches and bluegills up to 9 inches are already available for anglers.



Lake restoration funded the design and construction of a carp barrier in the Lake Miami spillway. This structure will ensure that carp will not reinvade the renovated fishery and thus, negatively affect water quality. The total cost of this structure was \$46,000 and was completed in May 2014.

A shoreline survey was conducted at Lake Miami in February of 2013. A total of 10,000 feet of priority shoreline was identified from this survey. Marine Fuel Tax funds were available for a shoreline restoration project in winter 2014/2015.

The Lake Miami shoreline restoration project was awarded at \$687,848.70. Funding for the project was through MFT and Lake Restoration funds. A total of 10,000 feet of shoreline were armored and the project was completed in March 2015. Rathbun Fisheries Management and the Monroe County Conservation Board jointly cut and placed several dozen cedar trees at 4 separate locations in



the lake basin in the winter of 2014/2015 as fish habitat. No additional fish habitat component of this project was completed due to a shortage of funding.

Mariposa Lake (Jasper County)



Mariposa Lake is an eighteen acre lake with a 575 acre watershed located in Jasper County. A watershed project was completed in 2011 to address erosion issues in the water. Local partners worked together to install The Jasper County Conservation Board completed bank stabilization practices on approximately 900 feet of shoreline using rock riprap and coconut fiber logs and has completed a 3-acre timber stand improvement project. An overgrown area over a gully was cleared to approximately 25% canopy cover to allow grasses to grow and seeded to native grasses and wildflowers.

In 2012, Jasper County Conservation installed a 3.9 acre wetland to collect runoff from 368 acres in the watershed and to help trap nutrients and sediment to prevent them from entering the lake.

New Mariposa Wetland Structure constructed in 2015.

In 2015 Jasper County hired an engineering firm, Shive-Hattery, to develop conceptual plans and engineering for a new outlet structure, sediment removal and park and angler access improvements. Shive-Hattery is in the process of submitting a joint application for these improvement projects. The firm will also be providing Jasper County with a proposal for Final Design and Construction Services of what is currently estimated as a \$2.5 million dollar project.

Pleasant Creek Lake (Linn County)

Pleasant Creek is a 401-acre lake owned by the State of Iowa with a watershed to lake ratio is 5:1. The State owns 90% of the 2,035-acre watershed. The other 10% is mainly in timber.

A meeting was held in October 2013 with DNR Parks, Lake Restoration and IDALS to develop a management approach and time line for restoring Pleasant Creek Lake. The plan was for DNR Fisheries and Parks to work cooperatively with IDALS to develop a watershed plan to address potential issues. Using information from the initial survey, there appeared be some opportunities to build some gully control structures on park property and review/update land management approaches on state ground to improve water quality. In-lake restoration will include shoreline riprap, shoreline deepening and fishing access improvement. Lake Restoration has planned for funding in FY15-FY17 for lake and watershed improvements.

Pleasant Creek Dam also had a crack around the valve housing and was leaking water. Divers were hired on August 6th to place a stop log structure over the intake pipe so the gate valves could try to be opened. The two 10 inch valves were opened, but the larger 24 inch valve would not open.

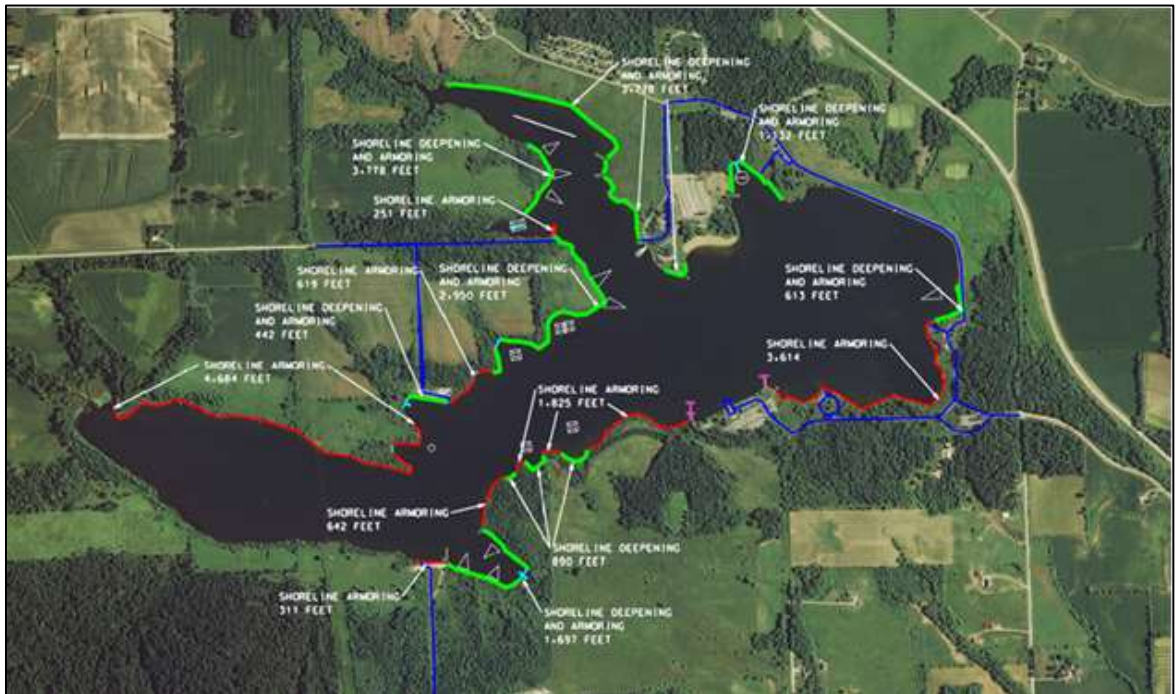


Divers installing a stop log structure on the intake pipe at Pleasant Creek.

The contractor was hired to try to open the 24 inch gate valve to see if it was be functional in the summer of 2015. Unfortunately, it was no longer functional so a new gate valve was ordered and paid for by DNR Lake Restoration. Gate valve replacement was completed on October 2nd; divers removed the stop log structure from the intake pipe and the valve was opened to begin the lake drawdown. The planned 15 foot lake drawdown was completed on October 23rd. DNR

plans to accelerate Pleasant Creek Lake restoration plans due to the availability of marine fuel tax funds. With the lake drawn down, in-lake restoration work is slated to begin in 2016.

Archeological field work was completed and final was submitted to DNR in late 2015. ***Final plans for shoreline stabilization, shoreline deepening, fish habitat, fishing jetties, and boat ramp replacements have been submitted for permitting (see picture below).***



In-lake work is currently budgeted for approximately \$2.5 million. Funding sources for the project include DNR Lake Restoration, the US Coast Guard, the Marine Fuel Tax Fund, and the Sport Fish Restoration Fund (~\$400k). DNR field work for the watershed assessment has been completed and the final report is expected in early 2016.

Prairie Rose Lake (Shelby County)

Prairie Rose Lake is a 173-acre constructed lake with a watershed to lake area ratio of 24:1. Low fish populations, siltation, and poor water quality plagued the lake in recent years, thus watershed and lake improvements were planned to bring this popular recreation destination back to life. Previous lake improvements included; jetties and fish structures (1998), sediment basin and shoreline riprap (2001) and sediment basins (2004); however, water quality in the lake remained poor. Shelby County SWCD conducted a watershed assessment followed by a joint Iowa Department of Agriculture and Land Stewardship / DNR Watershed Improvement Section grant to accomplish targeted soil conservation work in the watershed and reduce the amount of sediment and nutrients reaching the lake. The Shelby County Soil and Water Conservation District was awarded a \$510,611 Water Quality /Watershed Protection Project Grant in 2008. Through the Prairie Rose Water Quality Project, over 225,000 feet (40 mi.) of terraces were constructed, and numerous grassed waterways and nutrient management plans were added to the watershed reducing sediment and nutrient delivery to the lake by 60%.



2008 Water Quality/Watershed Protection Project led the way by reducing sediment and nutrient delivery to Prairie Rose.

- A Diagnostic and Feasibility Study was commissioned by DNR in the mid-2000s and completed by Iowa State University in 2008 to better understand water quality challenges in the Prairie Rose Lake Watershed.
- DNR, in partnership with Pheasants Forever, acquired a 77-acre dredge spoil containment site in 2010, an important component to the in-lake restoration work. Rock chute wetlands and road risers were constructed on public land on the four main drainages of the lake during fall 2011/spring 2012.
- Prairie Rose Lake was dewatered in July 2011 to allow construction work to begin in the basin. Stabilizing the eroding shoreline and removal of 60,000 cubic yards of sediment was completed during the winter of 2011-12. The spillway modification to prevent rough fish re-entering the lake from below is now in place.

- Additional fish habitat and shoreline access has been added to the lake basin utilizing \$150,000 of DNR Trust Fund dollars. In September 2012, the gate was shut and Prairie Rose Lake began to re-fill following the treatment of the watershed to remove undesirable fish species (e.g. common carp). By June of 2013, the lake had refilled.

Restocking Prairie Rose Lake began in April 2013 with largemouth bass, bluegill, and channel catfish. It will be another year before significant fishing gets started. The development of the fish population in the lake is on track. In addition to the largemouth bass, bluegill, and channel catfish populations already established in the lake, adult black crappie (800) were stocked during the fall of 2014. Fishing activity at the lake increased dramatically in 2015.



- The NRC accepted a donation of a permanent easement for storage of water for retention of silt adjacent to Prairie Rose State Park above the campground arm of the lake. The DNR accepted the low bid of \$109,966 to build a grade stabilization pond at this location. Construction was completed in 2015.
- The In-Lake Dredging project started moving sediment in mid-July. Contractor switched from a hydraulic dredge with a cutter head to a barge mounted excavator dumping into a slurry box because of the amount of terrestrial and aquatic vegetation. Approximately 185,000 CY of sediment was to be removed from Prairie Rose Lake.
- The In-Lake Dredging project was completed. Mechanical issues plagued this project throughout. The \$1.4 million project was expected to dredge 185,000 CY of sediment from Prairie Rose Lake. Early in October the contractor started to demobilized equipment. DNR Engineering is in the process of calculating the actual quantity dredged from the lake.

Prairie Rose Restoration Plan	Cost
Water Quality/Watershed Protection Grant	\$510,611
Containment site purchase	\$340,000
Phase 1: drain lake July 11, 2011	2012 and 2013
Two road risers and two wetland rock chutes	\$393,866
Spillway modification/M47 Structure/Gate Valve	\$185,242
Containment site construction	\$629,154
Mechanical dredging/Shoreline/Fish habitat	\$524,197
Fish renovation/archeological assessment	\$30,000
Increase storage of SE rock chute wetland	\$21,247
Phase 2: 2014 / 2015	2014/2015
Hydraulic dredging	\$1,479,988
Sediment pond construction	\$111,583
Increase storage of NE rock chute wetland	\$46,430
Prairie Rose Restoration 4 year total:	\$4,272,318



Prairie Rose Lake water quality went from water as green as the grass (pre-project) to water as blue as the sky (post-project).

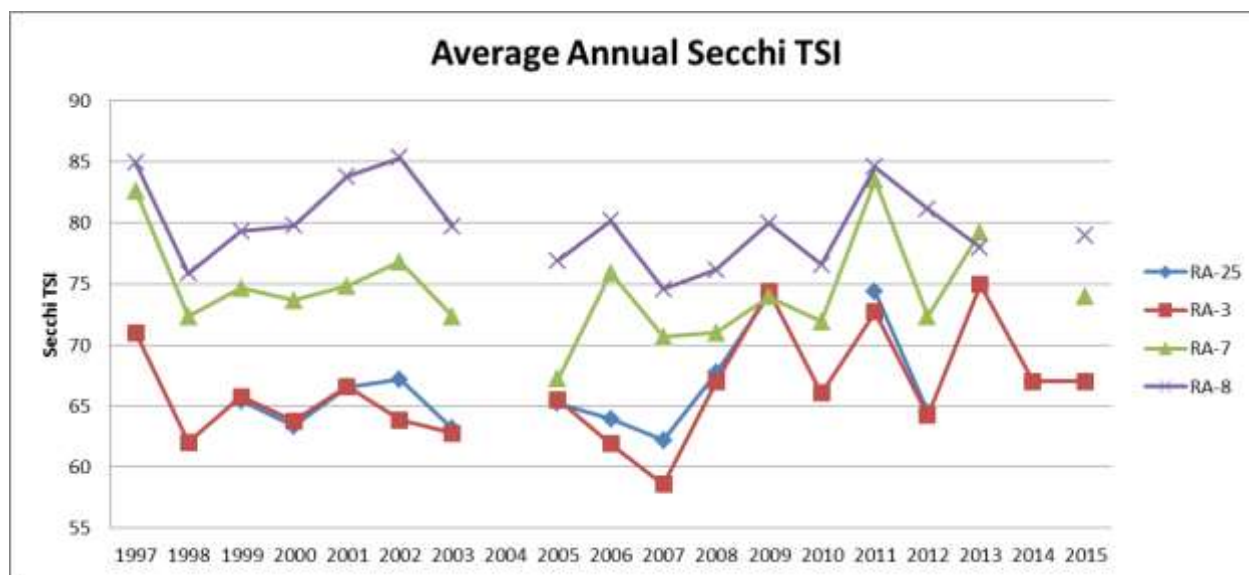
Rathbun Reservoir (Appanoose County)

Rathbun Lake, a federal flood control reservoir located in Appanoose County, is currently listed as impaired for its Class A1 (primary contact uses) due to high levels of algal and non-algal turbidity in parts of the lake. The lake frequently experiences water transparency of less than 1 meter, and the arms of the lake frequently experience dense algae blooms in the summer. A watershed improvement project for Rathbun Lake began in the late 1990's. The Rathbun Land and Water Alliance (RLWA) has spearheaded efforts in the 6-county, 354,000 acre watershed and partnered with the Iowa Department of Natural Resources (IDNR), the United States Army Corps of Engineers (USACE) and others to monitor streams in the watershed and several points in the lake. Watershed best management practices have been completed through key partnerships each year to protect water quality in Rathbun Lake. The table below shows work completed through a joint Iowa Department of Agriculture and IDNR Watershed Improvement Grant in SFY15.

Best Management Practice	Units Installed (July 2014-June 2015)
Water & Sediment Basins	23
Priority Land Seeding	130 acres
Grade Stabilization Structures	8
Debris Basins	0
Terraces	129,471 ft.
Grassed Waterways	0 acres

Water quality in the lake has remained relatively constant since monitoring began in the late 1990s in spite of considerable land use change in the watershed due to increasing crop prices and changes to CRP contracts. The figure below shows reflects the annual average water clarity (Secchi depth) through the Carlson's Trophic State Index (TSI). Iowa DNR uses the TSI to determine impairment status at a given

lake. A median TSI values of 65 or above indicates impairment due to low water clarity. High TSI scores indicate very poor water quality, usually associated with nutrient and sediment enrichment in a lake.



- Rathbun Land and Water has been successful in assisting 400 farmers with BMP application for priority land in 24 targeted sub-watersheds; they helped apply BMP on 16,500 acres (goal: 60,000 acres); these practices will reduce sediment delivery to Rathbun Lake by 25,600 tons per year (goal: 84,000 tons). In addition, these BMPs will reduce phosphorus delivery to Rathbun Lake by 110,400 pounds per year (goal: 360,000 pounds).

Rathbun Section 1135 Final Cost Share			
Total Project Cost		\$6,512,000	
Federal Share (Cash)		\$4,884,000	
DNR Share		\$1,628,000	
DNR Share Breakdown:			
Cash			\$1,548,000
In-Kind South Fork Construction			\$26,000
In-Kind S-13 Wetland Design			\$25,000
In-Kind Lands for S-13			\$29,000

- The State and Army COE have been working on in-lake work to protect vital habitats and improve water quality in several bays on the lake by protecting shoreline. Stabilized shoreline loss will reduced erosion and improve water quality. The COE is constructing the Rathbun Lake Habitat Restoration Project under Section 1135 of the Water Resources Development Act (WRDA) of 1986. Cost-share (75% COE / 25% DNR).
- Phase 1 of the Rathbun Lake Section 1135 project addressed seven sites with rock quantities exceeding 45,000 tons. In addition to water quality improvements, fish habitat was improved for a number of important game fish species. Work was completed spring 2011.

- Phase 2 of the Rathbun Lake Section 1135 project addressed the Honey Creek Resort Point. Honey Creek is a 300 plus acre arm of Rathbun Lake and provides some of the highest quality crappie spawning habitat available in the lake. Protection of the Honey Creek Resort Point will provide water quality benefits that will translate into improved crappie habitat and production, and secondarily will preserve resort infrastructure from flood damage. Total rock quantities placed exceed 40,000 tons. Work was completed spring 2012. The final phase of the joint COE/DNR Section 1135 project restored an additional 500' of shoreline and was completed fall 2012.
- A new Section 1135 start has been given by the U.S. Army Corps of Engineers. This new start will allow for the capture of additional funding on a 75% - 25% Federal / State basis for the construction of additional water quality improvements to Rathbun Lake. Of primary importance will be the continuation of shoreline ecosystem restoration, which will reduce shoreline erosion and improve water quality throughout the lake. The initial feasibility phase of this project is currently fully federally funded at \$100,000 and will include initial feasibility analysis of the project. Feasibility should be evaluated by March, 2016.
- Lake Restoration entered into a partnership with the Rathbun Land and Water Alliance to provide up to an additional \$250,000 annually to fund proposed activities in the Rathbun Lake watershed. These funds are to be matched against \$70,000 to be contributed by cooperating landowners and \$64,160 to be provided by the Rathbun Land and Water Alliance.

Storm Lake (Buena Vista County)

Storm Lake is a shallow natural lake (3rd largest natural lake in Iowa) with a surface acreage of 3,104 acres and a watershed to lake ratio of 5:1. The Diagnostic / Feasibility Study and the Impaired Water's Assessment both indicate that internal loading from re-suspension of bottom sediment is the primary source of nutrient availability and water turbidity, which supports dredging as a critical restoration approach to achieve desired improvement in water quality.

- DNR constructed a dredge spoil site at Storm Lake in 2001 and began dredging activities in 2001/2002. Lake dredging removed 1.32 million cu./yds. of sediment at a total project cost of approximately \$4.0 million during this first year of operation. Funding limitations restricted this initial dredging activity to 180-acres of the lake.
- The Lake Preservation Association (LPA) expressed a strong interest to continue dredging to achieve better water quality and from 2003 to 2013 has, in partnership with the state, dredged an additional 4,861,659 cubic yards of sediment. The City of Storm Lake leased the original DNR containment site and has since has constructed two containment sites east of Storm Lake.

Funds contributed to the project (2001 – 2012)

State allocation	\$8,942,920
Federal Allocation	\$1,765,000
City of Storm Lake	\$1,378,995 (Annually contributes a portion of Hotel/Motel Tax)
City of Lakeside	\$110,477 (Annually contributes a portion of Local Option Sales Tax)
Buena Vista County	\$680,000
Private Pledges	\$1,385,964

DNR Funds contributed to the project (2013 – 2014)

State allocation	\$1,873,405
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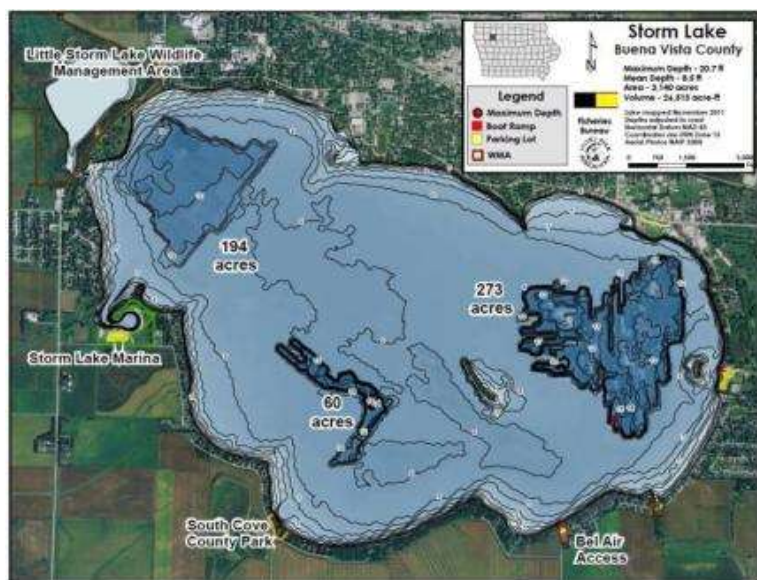
Economic Development – Storm Lake

Lake restoration efforts encouraged a \$35 million economic development named “Project AWAY SIS” that created an estimated 690 new jobs and more than \$28 million in spending in Storm Lake and Buena Vista County. “Lake restoration work for Storm Lake and its watershed has been the inspiration for the community to come together and chart its destiny into the future. This community has traditionally had most of its economic base centered on agriculture. Because of lake restoration work, our people determined that we could diversify our economic base by increasing recreational opportunities at Storm Lake,” said Jon Kruse, mayor of Storm Lake.

Joint (DNR/Local) Five-year Dredging Plan (FY17-FY21)

Storm Lake was mapped after the 2009 dredge season. At that point, the mean depth was 8.3 feet. Over the 2010-2015 dredge seasons, an additional 1,245 acre-feet was dredged, which increased the mean depth to 8.7 feet. The current dredge containment capacity is approximately 2.5M CY (1,550 acre-feet). Given a 3,140-acre lake, we will have the capacity to add 0.5 feet to the mean depth, which will result in Storm Lake having 9.2 feet in mean depth.

Year	Cubic Yards
2002	1,320,000
2003	50,000
2004	699,112
2005	548,389
2006	573,225
2007	527,837
2008	244,450
2009	559,966
2010	579,673
2011	550,604
2012	281,448
2013	246,955
2014	261,895
2015	87,000
Totals	6,530,554



Storm Lake mapped November 2011

ISU Storm Lake Dredging Analysis Study

Iowa State University, under the direction of Dr. John Downing, completed a study aimed to determine which areas of Storm Lake and to what depths Storm Lake could be dredged in the immediate future to yield the most reduction in sediment resuspension. In addition, this project explored alternative management scenarios that may further improve water clarity in Storm Lake.

DNR fisheries and lake restoration staff met with the City of Storm Lake and Iowa State University in March 2013 to discuss preliminary findings from the ISU study. A meeting was also held in November 2013 to discuss the final findings of that study and a presentation was given by ISU. DNR, City of Storm Lake, and ISU staff were present at the meeting. The information gathered from this study will help to

guide future dredging in order to get the most benefit for water quality. The goal is for the DNR and the City of Storm Lake to continue dredging at locations and to depths that will maximize our potential to reach our water quality goals within constraints of how much dredge spoil we can contain in existing containment sites.

Key take-home points from ISU Storm Lake Dredging Analysis Study

- 1) Current dredge only strategy will not be able to obtain water clarity goals unless stakeholders are willing to commit to dredging an additional 13.1 million cubic yards of sediment. At present, there is only storage capacity for 2.5 million cubic yards of sediment removal.
- 2) Dredging a larger surface area by removing less sediment in each location produce greater water clarity gains than dredging to deeper depths in a limited footprint.
- 4) Allowing degradation of the “big island” will have negative impacts to water quality.
- 5) If able to be successful in protecting existing islands, establishing islands independent of dredging may be a useful strategy to improve water clarity in Storm Lake.

DNR and the City of Storm Lake, based on information provided by the ISU study, are dredging at a (quantity, location, depth) that will maximize our potential to reach our water quality goals within constraints of how much dredge spoil we can contain. In addition, the DNR is moving forward with recommendation #4 and re-establishing existing islands back to at least their 1974 as-built condition. DNR fisheries has worked with DNR engineers to conduct preliminary surveys of the big island in Storm Lake and the plan is for 2016 construction.

DNR fisheries staff also met with Lake Restoration and city officials to discuss other alternatives for improving water quality and decreasing sediment mobility in Storm Lake. Specifically, to look for ways to settle out suspended settlement; look for ways to stabilize sediment at the bottom of the lake once settled out; and look for ways to build islands w/ in-situ materials, possibly as a function of dredging.

FYRA Engineering is nearing completion of a contract with Lake Restoration and the Lake Improvement Commission. FYRA has been working to determine the make-up of the suspended particles in Storm Lake that contributes to the poor water clarity. Once FYRA is finished running lab tests to determine the best flocculants to use for settling out these particles they will attempt some field trials. A public meeting was held in September to discuss the findings with the citizens of Storm Lake.



The 2015 walleye broodstock collection was a near record setting year for Storm Lake. Over 2,500 adult walleye were collected in the effort. A total of 373.25 quarts of walleye eggs were collected from Storm Lake and sent to the Spirit Lake and Rathbun hatcheries. This is the third best year in terms of quarts of eggs collected from Storm Lake since hatchery operations began there in 1988.

Fisheries technician Dray Walter holding a 29.5 inch female walleye collected during the 2015 broodstock collection efforts at Storm Lake.

Union Grove Lake (Tama County)

Union Grove is a 105-acre shallow constructed lake owned by the State of Iowa, with a watershed to lake area ratio of 63/1. It has 6,640 acres in the watershed with the vast majority is in private ownership. In the late 1980s, the state dredged the lake and installed an in-lake silt and nutrient dike on the north end of the lake. The DNR purchased an additional 60-acre parcel on the southwest side of the park and constructed a 10-acre pond. Union Grove Lake was last dredged from 1988 - 1990. Dredging from Union Grove Lake involved removal of 275,000 cubic yards of sediment accumulated since the lake was built in 1936.

Spillway water seepage had been an on-going problem at Union Grove Lake and past attempts to repair the problem had limited success. DNR hired a geo-tech firm in 2005 to evaluate the problem and contracted a firm in 2006 to repair the structure. The DNR completed the project in July of 2007 and successfully addressed the water seepage issue. Total project cost for the spillway repair was \$178,572, with the Lake Restoration Program as the funding source. The construction firm also made several recommendations for additional future spillway modifications that will preserve the integrity of the system at an estimated cost of \$40,000.

Union Grove Lake is on the Iowa's impaired waters list because of four limitations: pH, bacteria, algae, and turbidity. The Union Grove Lake Watershed Project has been underway since April of 2008. The project aims to reduce the soil and phosphorus reaching the lake, as well as reduce the effects of livestock on streams in the watershed.

As progress continued in the watershed, a 116-acre parcel at the top of the lake went to auction. This strategically important piece of land that filters 40 percent of the watershed was purchased by the Iowa Natural Heritage Foundation and held until the DNR's watershed improvement section, using EPA section 319 funds, and local supporters could purchase the \$695,000 parcel. This acquisition will be seeded with perennial prairie grasses and an existing wetland will be expanded providing permanent water quality protection for the lake.

Local partners, with the DNR have updated the plan to improve the lake and water quality conditions. The Tama SWCD Watershed Project Coordinator worked to revise and approve the Management Plan. In addition, the Tama County Sanitarian completed a report on a septic plan for the lake community.

DNR Lake Restoration has started working with our engineers on initial survey and planning and anticipate implementing shoreline stabilization, renovation of the fishery, modification of the spillway, habitat improvement and dredging from 2015-2017. As a part of the renovation plans, the lake is drawn down, fish will be eliminated to get rid of carp and yellow bass, and the lake outlet will be modified to prevent rough fish from reentering the lake. An improved Union Grove Lake when paired with the renovated state park will likely see increased visits and use of the area.

The renovated campground features a new shower house and bathroom, nine campsites with electricity, water and sewer connections and two campsites with electricity among the 25 campsites available. The \$400,000 campground renovation project was completed in 2012. Part of the renovation

included adding a new four season modern family cabin with air conditioning. DNR completed final designs for the dredging locations and for the containment structures. Construction of the containment site began in the fall of 2015. The proposed lake restoration options were presented at the annual homeowner's association meeting in fall of 2015.

A plumbing contractor was hired and on June 22, 2015, and the lake valve was opened to drain the lake (picture of drained lake shown below).



Other elements of the project underway in 2015 are highlighted below:

- Archeological study and final report have been completed.
- Containment structure construction started in November.
- Contracts for shoreline riprap, spillway repair and gate valve replacement are out for bid and construction is planned to start in January 2016.
- Final fish renovation will be conducted when the new gate valve is completed to remove any residual common carp and yellow bass left in the system.
- Lake is planned to be filled after the new gate valve is installed (currently slated for spring 2016).
- Lake dredging is planned to start summer/fall of 2016.
- Anticipated total costs for all work to be completed at Union Grove are ~\$2.2 million dollars, funded by the Lake Restoration Program. The containment site for dredge spoils is being donated by local project partners.

Lake Restoration Program (LRP) – Projects in Maintenance

Carter Lake (Pottawattamie County)

Carter Lake is a natural lake that is uniquely located in both Iowa and Nebraska. Carter Lake is an old oxbow of the Missouri River that was isolated from the river main channel in 1877. The lake is approximately 300 surface acres at conservation pool elevation 970.0 feet, with a watershed area of 2,675 acres (watershed area to lake area ratio of 8/1). The lake is approximately 75% in Nebraska and 25% in Iowa. Park areas in Nebraska and the City of Carter Lake in Iowa dominate land use adjacent to the lake. Problems at the lake have centered on poor water quality, chronic low water levels and nuisance algae bloom. Past impairments included nutrients/algae, indicator bacteria, and fish contaminants (PCBs).

- Carter Lake is a highly productive lake with a history of poor water clarity, high nutrient concentrations, frequent algal blooms, and periodically high bacteria. Given the nature of the problems at Carter Lake, corrective measures focused on the reduction of phosphorus, which is the driving force behind algal production. The goals pertain to protecting aquatic life and public uses of the lake such as recreation, fish consumption, and aesthetics.
- Restoration of Carter Lake involves the cooperation of Iowa, Nebraska and the cities of Omaha and Carter Lake. A local Iowa group, the Carter Lake Preservation Society (CLPS), has been very active in moving this project forward. In 2006, the cities of Carter Lake, Iowa and Omaha, Nebraska, requested assistance from environmental agencies in addressing water quality problems at Carter Lake. The Carter Lake Environmental Assessment and Rehabilitation (CLEAR) Council, with assistance from numerous local and state agencies, developed a conceptual plan to address water quality concerns. The community led steering committee finalized the Carter Lake Water Quality Management Plan in the spring of 2008.
- Fall 2008, the Metro Area Planning Agency (MAPA), with support of project partners, selected Tetra Tech, Inc. for the purpose of preliminary design and engineering of critical components of the Water Quality Management Plan for Carter Lake. Their work focused on the restoration alternatives of water-budget/seepage management, dredging, and storm water/in-lake alum treatment. By winter of 2009 project partners had enough information on probable cost, effectiveness and permitting issues to determine how to best move forward with implementation.

Project funding partners

Iowa Department of Natural Resources – Lake Restoration Program	\$2,494,624
Iowa Department of Natural Resources – Section 319	\$381,744
Iowa Water Quality Review Board	\$175,000
Nebraska Department of Environmental Quality - Section 319	\$1,120,000
Nebraska Game and Parks Commission	\$2,105,837
Nebraska Environmental Trust	\$400,000
City of Omaha	\$500,000
City of Carter Lake (in-kind)	\$250,000

- Metropolitan Area Planning Agency (MAPA) hired a project coordinator to work with both the local Watershed Council and agencies. One of their primary responsibilities was to finalize plans on a first

group of watershed improvement projects and have these projects ready to bid for final design/construction by fall of 2010.

- Project partners made significant progress at Carter Lake in 2010 with a spring alum treatment followed up by a complete fish renovation in the fall. Nebraska and Iowa, following the community accepted restoration plan guidelines established a no-wake zone on 100 acres of the lake in 2010 to lessen the impacts of recreational boating.



Wetland plants behind breakwater

- The Carter Lake fish renovation was a joint project involving Nebraska Game and Parks, the City of Carter Lake, and Omaha.
 - Applied 2665 gallons of rotenone on September 26, 2010
 - Physically removed 89.6 tons of fish (Approximately 600 lbs./ac)
 - Each worker handled ~ 10,000 lbs. of fish twice (pitched in & out the boat) in 3 days
- Clear water conditions persisted again

during the summer of 2014 allowing aquatic plants to fill a significant portion of the water column. Lifelong residents of Carter Lake commented that they had never seen the bottom the Carter Lake before. Due to the clarity and resulting response in plant growth a BMP for aquatic plants was drafted in consultation with the local communities to establish guidelines for future plant management efforts.

Almost immediately, visitors to Carter Lake saw drastically improved water clarity. Water quality data collected since the summer of 2010 showed that toxic algae blooms have declined, phosphorous and nitrogen concentrations are lower, and water clarity has increased.

- As part of the vegetation management plan the Technical Advisory Team authorized the chemical (herbicide) treatment of vegetation around public access points, canals, private docks, and ski club area. State agencies treated the public access areas in 2014. Local homeowners contracted a private aquatic pesticide applicator to treat vegetation around privately owned docks, canals, and ski club area. The TAT discussed various options, but ultimately decided to chemically treat a limited number of acres of open water areas to open up boating lanes. A permit to apply aquatic herbicide and a contractor were secured by the City of Carter Lake to chemically treat 100 acres of open water area with the herbicide "Reward" in 2014 and 2015.



- The lakes re-charge system was completed and activated in 2012. This system provided well water to Carter Lake during the dry summer assisting in vegetation management, dredging operations and recreational use of the lake.



One of two vegetation harvesters operated by the City of Carter Lake in 2015

- To address aquatic plant management needs at Carter Lake, Iowa and Nebraska purchased an aquatic vegetation harvester; operation and maintenance will be provided by the cities of Carter Lake and Omaha.
- A coordination meeting between the City of Carter Lake, the City of Omaha, Nebraska Game and Parks, and Iowa DNR was held in October, 2015. Past vegetation management was discussed and plans for 2016 were initiated.

Clear Lake (Cerro Gordo County)

Clear Lake is a 3,625-acre natural lake in Northwest Iowa. It has a watershed to lake area ratio of 2.3/1. In 2001, ISU completed a lake/watershed diagnostic/feasibility study. They presented a number of lake restoration options; specifically dredging of Little Clear Lake and restoration of Ventura Marsh.

- The DNR and local sponsors purchased a 208-acre dredge spoil site with approximately \$660,000 of LRP funds and an additional \$660,000 local match. Contractors completed the \$886,000 containment site in spring of 2008. The estimated cost of dredging was \$8 million dollars (2.3 million cubic yards at \$3.50/cu. yd.). DNR had a January 2008 bid letting for the hydraulic dredging of the Little Lake portion of Clear Lake and awarded the low bidder, L.W. Mattensen of Burlington, Iowa, the \$6,453,000 contract (75% LRP and 25% local-match funding).
- Dredging commenced in late spring of 2008 and completed by late summer of 2009. Contractors removed a total of 2.4 million cubic yards.
- In 2013/2014, the DNR lowered the dikes on the dredge containment site. Trees were also removed and pushed into piles. The Wildlife staff burned the trees during the past winter. Long-term plan for the containment site is seeding down to native prairie and management as a wildlife area.
- 1,500 feet of publically owned shoreline was protected with native stone rip rap in 2011. This work took place on the ice along the shorelines of McIntosh Woods State Park. One hundred twenty five feet of this project was along the State Dock area on North Shore Drive. An additional 750 feet of native riprap was completed for the State Dock area in 2013.
- The recently dredged west end of Clear Lake has continued to show improved water quality when compared to pre-dredged conditions. The recent monitoring data indicates that water clarity is returning to what was seen in the mid 1970's. The west-end sampling site has shown better water quality than the other two sites on Clear Lake now that dredging has been completed. Prior to dredging, the west end site showed poorer water quality than the other two sites. Overall, the water quality of Clear Lake has shown substantial improvement over the past ten years that

watershed and lake improvements have been implemented. Water quality remains excellent following previous restoration activities.

Section 206 U.S. Army Corps of Engineers

Aquatic Ecosystem Restoration Project for Ventura Marsh

- Construction is completed on a Section 206 U.S. Army Corps of Engineers Aquatic Ecosystem Restoration Project for Ventura Marsh, which flows into the west end of Clear Lake. In its present degraded state, the marsh serves as a major source of nutrients contributing to water quality problems in the lake and is a major reproduction area for common carp. The Army Corp of Engineers (COE) budgeted \$3.2 million for the Ventura Marsh restoration project. Ventura Marsh state land and in-kind credits of \$1,331,200 and approximately \$884,062 in LRP dollars will fund the DNR's portion of the marsh restoration project. The goal was to work with the COE to restore Ventura Marsh and gain water level management capabilities. This will allow for fish removal and revegetation of the marsh.
- The old stop log structure was removed and replaced with a new structure in 2011. The stop log structure will be used to control water levels from the marsh crest elevation down to Clear Lake's water level. For water level manipulations below Clear Lake's level, the pumping station will need to be used. A flow path was dredged in 2011 to allow the deeper portions of the marsh basin to drain towards the pumping station. This will allow nearly a complete drawdown.
- In 2013 /2014, DNR constructed of a catch basin and a water flow path in the southwest corner of the marsh. This feature will treat water entering the marsh from two large tile sources and allow for longer retention of water entering the marsh before it gets to Clear Lake. The implemented project established two sediment basins to treat major tile inlets in the southwest corner of Ventura Marsh.
- Rotenone was applied to the dredged trench to kill the carp reproduction that occurred in the marsh. The treatment was effective in the area of the Ventura Grade, but live carp were likely present in other portions of the basin and watershed for the marsh. Stop logs were removed and Clear Lake and water was allowed to flow west into Ventura Marsh. The water level stabilized with the current lake level, which gave adequate levels in the marsh to allow for waterfowl hunting opportunities.



In 2015 the DNR completed finish work on the Ventura grade project. This work included placing a concrete pad on top of pump station outlet / carp capture structure (jetty) and adding a chain link fence panel to bottom railing section of pump outlet to prevent carp from jumping onto the shoreline area. In addition, DNR installed metal grating over the area between the Ventura Marsh stop logs and the County Road S14 culvert to prevent rough fish transport and jumping into Ventura Marsh.

Anticipated Benefits

The total cost of all above activities is approximately \$17.0 million. Of this amount, local and federal match represent 40% of the funds necessary to complete these restoration efforts. Restoration efforts and improvements in water quality have the potential to double the annual economic return that Clear Lake generates to the local economy. The Center for Agriculture and Rural Development at ISU has projected a significant benefit to cost ratio from lake and watershed restoration at Clear Lake. Restoration of Ventura Marsh will improve the water quality of Clear Lake and help keep the Carp population under control. Local groups and DNR Section 319 continue to pursue watershed projects that have the potential to decrease sediment delivery to Clear Lake.



Carp are back in Ventura Marsh, but water quality remains excellent. Dense beds of cattail exist on 80% of the basin.

Photo by Zenner, October 2014

Green Valley Lake (Union County)

Green Valley Lake is a 390 acre lake constructed in 1950. It has a watershed to lake ratio of 11:1. The DNR implemented a limited lake restoration project through the State and U.S. EPA's Clean Lakes Program in the mid-1980s, however additional watershed and in-lake work was needed. Project partners initiated current restoration efforts at Green Valley Lake in 2006.

The local district soil group and NRCS completed a watershed assessment and developed a four-year plan to make needed watershed improvements. Cost share funding allowed local landowners to accomplish soil and water quality improvement projects on their property. Iowa State University completed a Diagnostic Feasibility study in 2008 and presented a variety of restoration alternatives (i.e. spillway modification, fish restoration and dredging of coves) for consideration. A technical workgroup that included DNR staff, NRCS and SWCD staff, the City of Creston, Southern Iowa Rural Water, Green Valley Chemical and CIPCO coordinated project activities.

DNR Parks has worked in parallel with lake improvements efforts to complete a facelift to the park. Including, adding full hook-up sites, removing a number of campsites to increase the size of each site, redesigning all the camping pads, a new electrical system upgrading from 30 amps to 50 amps, each site will have a new picnic tables and fire grills and a new shower building was installed. DNR Parks added new pit latrines at the campground, the cabins and the north picnic area and built a third camping cabin. Green Valley also has a new playground that was donated in part by the family of Greg Haley, who was

the park manager when he passed away in January 2009, and built by volunteers. In addition, the park was connected to the City of Creston by a paved bike trail in 2009 that allows park visitors easy access to the amenities in town.

- The local NRCS District Conservationist has implemented a four-year, \$409,000, watershed improvement plan and completed approved soil and water quality improvement projects.
- Recent fish population estimates had supported the presence of high numbers of yellow bass and common carp, species both considered detrimental to sport fish populations, with common carp having the additional negative impact of contributing to poor water quality conditions. The DNR renovated the fishery in September 2008 and has since restocked the lake with bluegill, largemouth bass, channel catfish, crappie and walleye.
- The concrete spillway had starting to develop some structural problems and its design allowed common carp to enter the lake during high outflow periods. Iowa Bridge & Culvert LC completed a redesigned spillway in May 2009 at a cost of \$510,435. DNR awarded a \$348,767 contract to CL Carroll Company Inc. for in-lake fish habitat and protecting of the existing shoreline. Fish Habitat Stamp funds in cooperation with Federal Dingell-Johnson, Marine Fuel Tax and Lake Restoration Program funds paid for this aspect of the project.
- The Natural Resource Commission approved the acquisition of a parcel of land with LRP funding. The land is located 2.5 miles north of Creston, and adjacent to the northeast corner of Green Valley State Park. The Betty E. Gater Estate offered this 67.58-acre parcel for \$338,000. This site is serving as a storage area for sediments removed from the Green Valley Lake during the lake restoration process and will be re-shaped and seeded down spring 2012.
- Taylor Construction & Excavation signed a contract in the fall of 2009 for removal of approximately 250,000 yards of sediment targeted from both existing sediment retention basins and in-lake areas. In addition, a new sediment dike was installed at a location below an area identified in the diagnostic study as a subwatershed area contributing significant sediment and nutrient loading and critical areas of shoreline were stabilized.
- The campground at Green Valley State Park opened in 2013 after being closed for nearly two years for renovations. The campground features full hook-up sites, each site has been enlarged and camping pads redesigned, a new electrical system now provides up to 50 amp service, and a new picnic table and fire grill at each site. The campground has a new shower building and pit latrines were added at the campground, the cabins and the north picnic area.
- Spring 2015 electrofishing indicated good numbers of largemouth bass up to 20 inches in length. Bluegills were captured in lower abundance, but bluegills up to 9 inches in length are available to anglers.
- DNR Engineering is in process of raising the west silt dike to maximize sediment trapping efficiency. Estimated cost is \$140,000.
- Trail construction around the lake is currently in progress and repairs to the silt dike above the lake are planned for re-design and bidding in early 2016.

There is a lot of rooted vegetation establishing around the shoreline of the lake that will provide excellent habitat and food resources to fish in the coming years.

Lake Anita (Cass County)

Maintenance activities at the 159-acre Lake Anita over this past year included expansion of the sediment retention basin above the east arm of the lake. The box culvert at the road was raised four feet and 8,000 cubic yards of material was removed all in an effort to increase the trapping efficiency reducing the sediment and nutrient delivery to the lake. This project will benefit the lake for the next 30 years.

- What started out to be a project to take advantage of drought conditions and clean out a nonfunctioning sediment retention pond at Lake Anita ended up with a total rebuild. NRCS engineers provided us with a design to raise the water level four feet by modifying the box culvert. In addition to raising the water level, 8,000 CY of dirt was removed from the upper end to act as a sediment trap. Combined this will extend the life of this sediment pond by an estimated 30 years and allow for water level control (management capabilities) of the east pond. Cost of the project was \$41,000 and funded through Lake Restoration.

Lake Anita aquatic vegetation treatment areas (Photo at Right)

- The water quality and fishery at Lake Anita continues to meet Lake Restoration goals on an annual basis. In 2013, Lake Anita had an estimated 64 surface acres vegetated or 39% of the entire lake surface area of the lake. This amount of vegetation is at the top end of the recommended 10 to 40% range optimal for growth and survival of fish.

In 2014 and 2015, a significantly larger area of the lake was treated. A total of 15 acres in three locations were treated with aquatic herbicide Reward. This reduced the vegetated area of Lake Anita down to 28% of the total surface acres, improving access to the lake and enhancing the fishery.



Lake Darling (Washington County)

Initially impounded in 1950, Lake Darling had historically been a fair fishery plagued by severe in-lake siltation and poor water quality. Sedimentation had reduced the lakes original 305 surface acres to 267 acres. During the last five years, extensive watershed soil conservation work on state and private land has reduced sediment delivery to the lake by 60% and laid the groundwork for a complete renovation of the lake and park. All in-lake improvements were done while the lake was drained and the goal is to sustain these improvements over the next 50 years.

The park reopened in late July 2014 after being closed for renovation since 2010. In September 2014, more than 200 people gathered under a new shelter to officially rededicate Lake Darling State Park, 64 years to the day that the gates were formally set. The \$13 million investment to improve and protect the lake and completely remake the campground and park roads is now complete, returning the park to its

status as a destination for outdoor getaways. Speaker after speaker thanked the Lake Darling Friends Group, the Washington County Riverboat Foundation, the local chapter of the Izaak Walton League, the Iowa Department of Natural Resources, local landowners, the Washington County Board of Supervisors, the Brighton Chamber of Commerce, the Iowa Legislature and area residents for the role they played in the renovation.



In September 2014, more than 200 people gathered under a new shelter to officially rededicate Lake Darling State Park, 64 years to the day that the gates were formally set.

Dr. Fay Vittetoe, representing the Friends of Lake Darling and the Brighton Chamber of Commerce, presented two framed paintbrushes used by Jay N. 'Ding' Darling, to the Federation Bank in Brighton and to the farm community for their role in the park restoration and commitment to protecting the lake.

She said their work is not finished, noting that ***the friends group has gone on to raise about \$500,000 in additional funds towards adding four season cabins to the park, and is working on plans to connect a bike trail from the park to the Brighton.***

Lake Darling Restoration Project Activities

- Replacing the dam
- New sediment catch basins in the watershed
- Two silt dams in the lake
- Lake level raised two feet to increase surface acres back to 305 acres
- Installed shoreline riprap, fishing jetties and piers
- New ADA fishing trail
- New roads
- New campground, with 50 amp service
- New boat ramps
- New shelter at boat rental area
- New sand on the beach
- New waterlines throughout the park
- Two new shower buildings
- New dump station
- New fishing bridge
- New trail bridge and others refurbished
- New park lodge

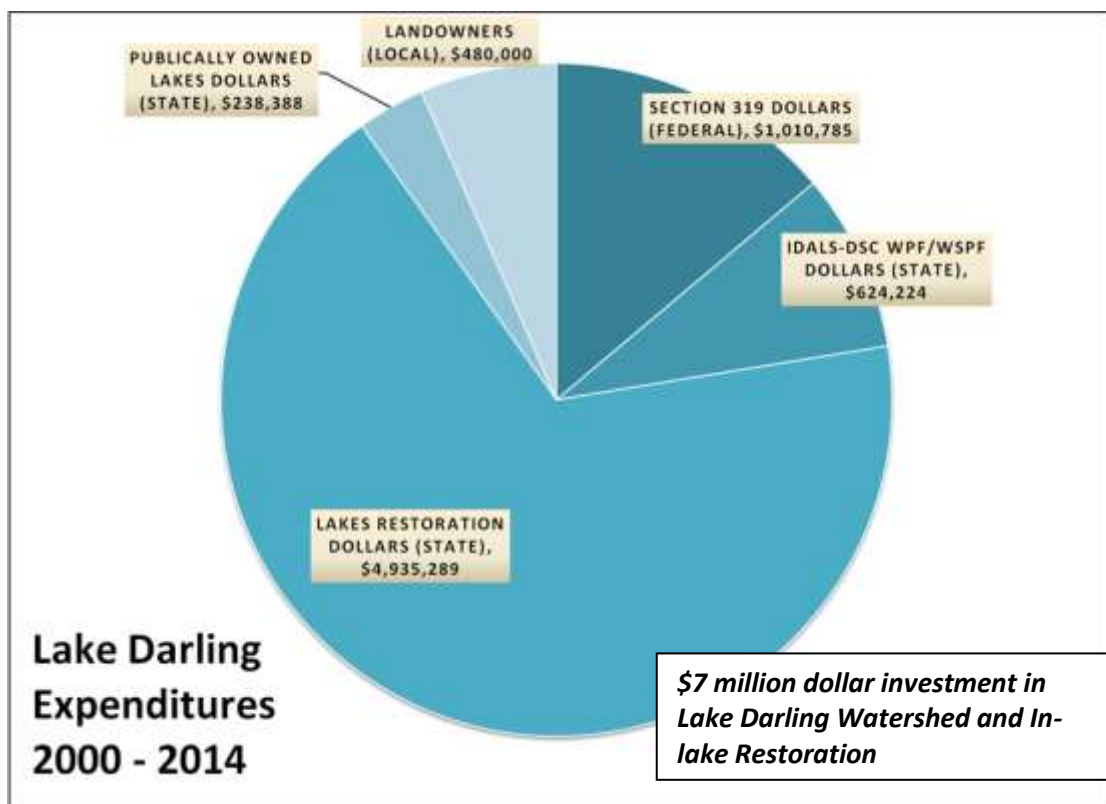


Funding Sources: Lake Restoration Program, Parks & Institutional Roads, Fish and Wildlife Trust Fund, Sheldon Shoreline Access Foundation, Washington Co. River Boat Foundation, Izaak Walton League, Friends of Lake Darling, REAP Land Management, and REAP Open Spaces

New picnic facilities for visitors to enjoy at the park. Photo by Jo Eland.

Investment in Lake Darling State Park

New state park lodge (local fund raising from the Friends of Lake Darling)	\$1,000,000
Park Infrastructure	\$3,500,000
Campground electrical system upgrades	\$600,000
New shower house	\$200,000
New campground sewer system	\$700,000
	\$6,000,000



The \$13 million investment to improve and protect the lake and completely remake the campground and park roads is now complete, returning the park to its status as a destination for outdoor getaways.

Landowners need to be recognized for their role in protecting the lake. Stan Simmons, the watershed coordinator who played a significant role in working with landowners to install more than 160 ponds, terraces, water control basins, soil-holding grasses and other conservation measures, accepted a water quality initiative leadership award on behalf of the project from Iowa Secretary of Agriculture Bill Northey.

The new park will provide important health and economic benefits through visitation and outdoor recreation. An economic study by Iowa State University's Center for Agriculture and Rural Development estimated the renovated park and lake would provide \$8.7 million annual economic benefit to the area and complements Iowa's improved quality of life initiatives. "Businesses are looking to locate to areas that provide a healthy place to live, work and play," added Iowa Department of Natural Resources Director, Chuck Gipp.

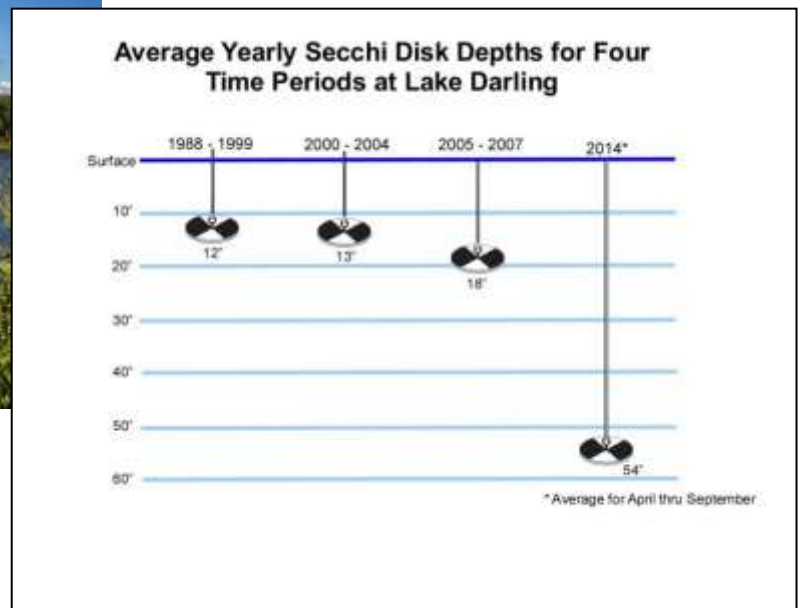
Immediate water quality improvements



Photo by Jo Eland

Image to the right shows Secchi Depth, a measure of water clarity and indication of water quality over time.

(1988-1999): pre widescale implementation of watershed conservation practices; (2000-2004): the first years of extensive watershed improvement; (2005-2007): post major watershed work and before in-lake restoration and (2014): current status after completion of additional watershed improvement practices and in-lake restoration.



2015 and Beyond

- A Documentary titled, "Darling is Back" was created highlighting the partnerships and work completed in the watershed and at the park. Many members of the restoration project were interviewed during the filmmaking. The film premiered at Lake Darling State Park on December 12-13, 2015, and it planned for release on PBS in the near futuer. The Lake Darling Restoration Project is sure to be a model for future projects in Iowa, and likely, the nation.

- Construction on the \$1.1 million (99% other, 1% P&I) four season cabins began in 2015 (See photo below). A total of 6 cabins were constructed and are nearly complete.
- The “Ding” Darling bronze bust and interpretive panels were placed at the entry to Lake Darling State Park. Labor and funding for the project was provided by the Lake Darling Friends Group.



- Redear sunfish fingerlings were stocked in Lake Darling September 2015.
- Fall fish surveys revealed excellent growth; bluegills up to 7.5”, a fair number of bass just short of 15”, and an abundance of crappies around 8-9”
- Water clarity is 5-6 ft. during periods of little to no rain. Algal blooms were common during the summer months; subsequently, water clarity was reduced during this time period. Presence of aquatic vegetation in shoreline areas is now common whereas pre-project, it did not exist.



Future Projects

- New Pit Vault Toilet at Campground Boat Ramp, \$36,000, 45% MFT/10% Infrastructure 2015/45% Federal Boat Safety (Coast Guard).
- Interpretive Trail from cabin road to beach area, \$85,000, 100% REAP.
- Cabin Road Construction, Cost Not Available, Eligible portions will be paid with P&I funds; Non-eligible portions will be paid with 50% infrastructure/50% private donations.

Lake Icaria (Adams County)

Lake Icaria’s clarity used to be measured in inches; it is now measured in feet. Before, you could only see down six inches in the murky waters of this southwestern 647 acre Iowa lake. Now, following work in the watershed and in the lake, you can watch your toes wiggle when standing in waist-deep water. Landowners set out in 1996 to improve the lake as part of the Adams County Three Lakes Project. In the past decade, landowners have changed how they farm to improve water quality.

Following work in the watershed, the DNR moved ahead with restoration efforts in the lake in 2004. At Lake Icaria, in-lake work has helped protect 10,000 feet of shoreline from erosion. Anglers will notice four new fishing jetties, repaired jetties and a repaired main boat ramp, as well as a renovated fishery and restocked lake. The DNR also placed 12 underwater rock mounds to attract fish for anglers. Since Lake Icaria completely refilled in the spring of 2007, the water is remarkably clearer – generally, a person can see three feet down in the water, sometimes up to six feet. With an improved lake, anglers, campers and other park visitors are taking notice. Starting in 2008, fishing and park visitations have improved. In-lake work has helped protect 10,000 feet of shoreline from erosion. Anglers will notice four new fishing jetties, repaired jetties and a repaired main boat ramp, as well as a renovated fishery and restocked lake.

- The DNR Lake Restoration Program cooperated with the Adams SWCD by providing funding resources to repair and improve the main tributary wetland that was originally constructed in 2004. In 2013, the DNR contracted with Murphy Heavy Contracting Corp. to repair the wetland at a cost of \$386,028 (WIRB grant to the SWCD paid \$170,525 and the Lake Restoration Program paid \$215,503). Construction was completed September 2013.
- In addition, Adams CCB applied for a fish habitat grant for four sediment control ponds above Lake Icaria. The DNR and Adams CCB coordinated planning for these structures during the winter of 2012/2013 and the ACCB constructed these ponds during the summer of 2013 at a cost of \$67,221 (Fish Habitat Grant \$34,871, SWCD \$22,500 and Lake Restoration \$9,850).

In 2014, the DNR repaired the existing riprap shoreline along the point that surrounds the Primitive Campground at Lake Icaria with more riprap.



- Good numbers of 14-20 inch largemouth bass were captured during spring electrofishing in 2015. Bluegills and crappies were also captured in lower abundances, but bluegills up to 9 inches and crappies up to 11 inches were observed. Good numbers of young-of-the-year walleyes were also captured in 2015, indicating that the future of the fishery looks bright.

Lake Macbride (Johnson County)

Lake Macbride is a man-made 889 acre lake located near Saylorville Reservoir in Johnson County. The lake has a 20 to one watershed to lake area ratio and a mean depth of 15 feet.

A timber management plan has recently been implemented at Lake Macbride to reduce the soil loss within the Park boundaries. The contractor removed and chemically treated undesirable trees and

shrubs on 50 acres to open up the canopy to promote natural plant regeneration. Burning is being used to remove dense leaf litter and help control invasive plants.

Little River Watershed Lake (Decatur County)

Little River Lake was created in 1985 as a multipurpose PL-566 structure to reduce flood damage, provide drinking water for the City of Leon and Decatur City, provide an established fishery, and to provide recreational opportunities for Decatur County and neighboring areas. Little River Lake is a 788-acre lake with a 17:1 watershed to lake area ratio. For the first 15 years, the lake produced tremendous quantities of quality fish. However, common carp, an inadequately protected watershed, and unprotected shoreline problems have reduced water clarity, suppressed sport-fish abundance and growth, recreation opportunities, and increased water treatment costs. The lake had no shoreline protection in place at its initial impoundment construction. Shoreline erosion, silt loading, and a common carp population have all adversely affected water clarity. Fish quality and angling activity have steadily declined since 2000 to a point where the lake offered few sport-fish or angling opportunities today.

The Decatur County Soil District and the NRCS have completed a watershed assessment and have developed a four-year plan to make needed watershed improvements. Cost share funding was made available for local landowners to accomplish soil and water quality improvement projects on their property.

- Decatur County, Southern Iowa Rural Water Association, Decatur County Conservation Board, Decatur County Soil and Water Conservation District, the City of Leon, and the Iowa Department of Natural Resources began planning water quality improvement efforts in 2008. Since that time, the group has met to plan and implement water quality improvement practices for the watershed.
- The Decatur County Soil & Water Conservation District and NRCS personnel assessed the watershed's problems, quantified soil erosion, and identified best management practices, (BMPs). The Watershed Improvement Review Board (WIRB) awarded the Decatur SWCD a \$423,900 grant to cost-share improvement costs with landowners. The group also received a letter of support from the DNR Lake Restoration Program to consider Little River Lake for future funding for in-lake improvement projects. Pending adequate implementation of watershed soil conservation practices, Lake Restoration funding will address in-lake improvements such as shoreline stabilization, rough fish management and silt basin improvements.
- The restoration process during 2011 involved implementation of remaining targeted watershed practices with available WIRB funding. Re-assessment of the watershed will guide planners to any remaining areas of the watershed to address before potential work in-lake.
- The local NRCS District Conservationist has implemented \$384,419 of WIRB funding, \$214,359 of EQIP funds, \$192,471 of Public Owned Lakes funding, \$100,865 of State cost share funding, \$14,793 REAP funding, and \$316,439 of landowner commitments totaling \$1.2 million to improve the watershed and complete approved soil and water quality improvement projects. To-date less than \$20,000 of WIRB funding remains available. Landowners in the watershed receive bonus points when competing for countywide funding from the Soil District and NRCS.
- Recent fish population estimates had indicated a dense common carp population. Their feeding for bottom organisms suspends fine clay sediments causing poor water clarity. The DNR renovated the fishery in October 2011 and in 2012 restocked the lake with walleye, largemouth bass, bluegills,

crappies, and channel catfish. Fish population surveys conducted during 2012 has found excellent growth and survival of all stocked species.

- The elevation of the dike and outflow chute of the wetland above Little River Lake was raised two feet to allow additional storage capacity. The additional area is expected to restore wetland's sediment and nutrient trapping efficiency. Expansion of the wetland area above Little River Lake (completed spring 2012 at a cost of \$207,340 paid for by Lake Restoration) doubled the area, improved sediment trapping capabilities above the lake and allowed for water level management of the wetland.
- In 2011, the DNR awarded a \$1.1 million contract to TK Concrete of Pella for shoreline deepening, shoreline stabilization, and in-lake fish habitat. The Lake Restoration Program funds paid for \$880,000 million for shoreline improvements and Fish Habitat Stamp funds in cooperation with Federal Dingell-Johnson, Marine Fuel Tax funds paid for \$220,000 in fish habitat improvements. Construction was complete spring 2013, the DNR renovated the fishery and re-stocked gamefish, and the lake has now re-filled.



Shoreline stabilization of regions with significant erosion

Little River has water clarity of over 10 feet at times. This level of clarity has not been seen since the lake's initial impoundment in the late 1980's. ***Post restoration water clarity measurements at Little River Lake routinely exceed 36 inches and have been over 80 inches.*** The largemouth bass population has a very strong 2012 year class. Growth for bass increased from that found in 2012 and all sizes have good body condition. Bluegills of all sizes are present ranging from 1 inch to 8.5 inches with a lot above 7.0 inches. It produced a moderated size fish for the ice fishing season and following spring. The 2012 walleye stocking survived well. However, none of the 2013 stocked fry or 2-inch fingerlings were found.

Little River Lake is becoming a popular destination for walleye anglers. Good numbers of 12-20 inch walleye were captured during 2015 sampling. The bluegill population is increasing with fish up to 9 inches available to anglers. Spring electrofishing also indicated a high abundance of largemouth bass up to 18 inches in length.

Little Wall Lake (Hamilton County)

A local working group began meeting in 2014 to discuss lake management options centering on lake water levels. The group looked into future management of the dredging containment site used for 2002 dredging. The group also discussed the possibility of a low dose rotenone treatment to remove grass carp and yellow bass from the lake to improve the fishery for anglers, alternate water sources for lake level enhancement on dry years, and improved public access facilities and opportunities.

The working group met again in the spring of 2015 with members of the public seeking input on direction for the lake. The group decided to take no action at this time given the conflicting desires for management of the lake. Managing the lake for a higher quality fishery and better water quality would require chemically treating the lake and likely create an abundance of aquatic vegetation in this shallow system. While this would create better opportunities for anglers, it would prevent power boaters from using their boats and jet skis on this lake.

Lizard Lake (Pocahontas County)

Lizard Lake was a highly degraded 285-acre shallow natural lake. Rough fish (buffalo, bullhead and carp) dominated the lake population. The lake contained limited aquatic vegetation and exhibited poor water quality. A local lake group has promoted lake restoration and they continue to meet with DNR staff to discuss their concerns. In June 2006, IDALS and the local Soil and Water Conservation District awarded a Development Grant to evaluate the watershed of Lizard Lake.

The Iowa State University Limnology Laboratory conducted a Diagnostic Feasibility study for Lizard Lake. This 2008 study, completed by Dr. John Downing, states that Lizard Lake is one of the most eutrophic lakes studied in Iowa. As part of potential restoration alternatives, ISU presented "shallow lakes management" as an option for improving the lake's water quality, fish population structure and wildlife potential. During 2008 and 2009, DNR staff has met several times with local partners and stakeholders to discuss shallow lake management options for Lizard Lake. Many stakeholders recognized the benefits of shallow lake management and expressed a preference for that type of management. Other stakeholders, while preferring dredging, realize that high dredging costs make that option unattainable and therefore support shallow lake management. Other stakeholders preferred to continue supporting dredging as the only alternative.

With strong support from most local constituents, the DNR hired Ducks Unlimited to conduct survey work during winter 2009 and plans to construct a water control structure and fish barrier. Construction of a new water control structure, fish barrier, and improved draw down channels was completed in 2011. DNR drained the lake to eliminate high populations of common carp and other problems fish, allow for the consolidation of loose bottom sediments, and promote the growth of aquatic plants. These plants will help keep water in the lake clean by holding down bottom sediments, reducing wave energy, using up nutrients otherwise available for growing algae, and provide habitat for the small invertebrates that eat algae. Aquatic plants will also provide excellent habitat for sport fish and a multitude of game and nongame wildlife species that depend on clean-water lakes for survival.

- Lizard Lake was drawn down during the winter/spring of 2011 as planned. The draw-down went very well and the wildlife biologist was able to achieve a complete draw down. Cooperating weather conditions allowed vegetation to flourish in the exposed lakebed.
- Construction activities on and around Lizard Lake were completed as planned. A new outlet and water control structure was installed to replace the antiquated one. A private firm was contracted to survey the outlet structure to assure local citizens that the new outlet structure was installed at the same elevation as the old one.
- A velocity tube fish barrier was installed just downstream of the outlet structure at Lizard Lake. This fish barrier is the first of its kind as it allows debris to flow through the structure, but does not allow fish to pass through it because it is installed at a steep enough grade.

In 2012, Lizard Lake went through its second year of a draw-down since the project's inception. Good stands of perennial emergent vegetation were established. We attempted to hold three feet of water in the basin throughout the summer and then bring the lake up to crest by fall. The drought kept us from achieving that goal. DNR did attempt to stock yellow perch into the lake when there was several feet of water; however, the lake basin dried up after they were stocked.

Although we were not able to hold water in the lake, it was there long enough to inhibit emergent plant growth in the deeper portions of the lake, which created open pockets of water. DNR fisheries staff met with the Pocahontas CCB in March 2013 to discuss plans for Lizard Lake for the 2013 season. 50,000 yellow perch were stocked into Lizard Lake in July. Many locals were present for the stocking and a good article on the stocking was published in the local paper. All of the stop logs are currently in place to hold as much water as possible going into the 2014 season. Also in 2013, the DNR acquired 120 acres of land in the watershed of Lizard Lake. This land will be protected in perpetuity and help to improve water quality in Lizard Lake. The land also provides more shoreline access for the public and connects two existing pieces of public property. DNR fisheries staff has been monitoring water levels at Lizard Lake and have assisted with stocking adult perch and fertilized perch eggs. Northern pike were also stocked in June of 2014. DNR fisheries staff has worked with the local press to publish articles related to fish stocking and progress at Lizard Lake throughout the year.

Land Acquisition (MFT, REAP, Fish Habitat Stamp, Wildlife Habitat Stamp)

Approximately 110 acres of land on the north side of Lizard Lake was purchased by the Iowa DNR. Funds from MFT, Reap, fish habitat stamp, and wildlife habitat stamp were used to buy the property. The majority of the property lies within the watershed of Lizard Lake and connects the public property on the west and east sides of the lake. The land will be planted to native grasses and forbs and any restorable wetlands will be re-established, which will improve the water quality in Lizard Lake and protect that part of the watershed in perpetuity.

Access Improvement

Aquatic vegetation has flourished in Lizard Lake since the restoration and subsequent refill of the lake basin. However, the vast majority of vegetation is emergent plant life consisting mostly of cattails over 90% of the basin. Approximately 55 acres of cattails were treated with Rodeo (an aquatic version of Round-up) in early September of 2015 to improve access and create more open water. Fish and wildlife managers will monitor the effects and make decisions on future herbicide applications based on the results.



Aerial photo of Lizard Lake, fall 2015. Light brown areas have been treated with glyphosate to improve access and navigation.

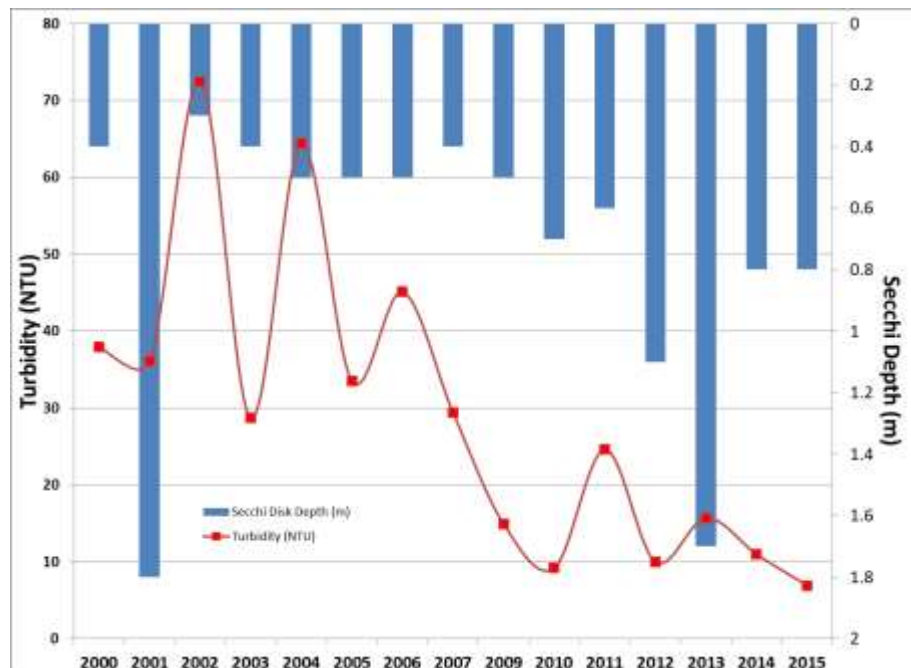
Lost Island Lake (Palo Alto County)

This is an aggressive and comprehensive plan to improve water quality in the > 2,200-acre complex, which includes the 1,162-acre lake. The plan includes reducing existing carp numbers, preventing remaining rough fish from entering most spawning areas, conducting beneficial drawdowns on associated wetland areas (780-acre Barringer Slough, 150-acre Blue-wing Marsh) and eliminating rough fish. Resulting germination of aquatic plants and consolidation of bottom sediments will restore proper wetland function and improve the water quality at Lost Island Lake.

- The project includes an innovative plan to allow for the removal of up to 75% of the existing carp biomass, aggressive stocking of predatory fish and new construction or rehabilitation of four water control structures and five fish barriers throughout the complex.
- During summer 2008, DNR-Fisheries used mark – recapture techniques to estimate in-lake carp numbers and biomass and initiated an intensive commercial fishing contract, which resulted in the harvesting of approximately 427,000 lbs. of carp and 353,000 lbs. of buffalo in 2010. The result has been a 90% reduction in population and 80% reduction in the biomass of rough fish.
- DNR awarded Ducks Unlimited, Inc. a contract to design effective water control and fish barrier structures. The survey and design work began during summer/fall 2009. Local excitement regarding the project is high. Nearly 70 local stakeholders attended a December 2009 public meeting and voiced strong approval for the design work.
- The NRC approved Lake Restoration Funding toward the \$834,263 bid from Landwehr Construction, St. Cloud, MN for the project. The Watershed Improvement Review Board awarded the Palo Alto County Conservation Board \$180,000 to cover part of the cost (two water level control/fish barrier systems); construction began in the fall of 2010 and was completed summer of 2012. The \$1.3 million project is a partnership between the Iowa Department of Natural Resources, Palo Alto County, Ducks Unlimited, and the Lost Island Protective Association.

- Various basins within the complex have been dewatered to eliminate rough fish, create favorable conditions for re-vegetation. Weather permitting; all basins should be at full pool during fall 2013 thereby providing excellent habitat for wildlife species and much-improved recreational opportunities for Iowans. Some additional minor work will be completed at several of the structures to ensure the entire system works efficiently and there are still plans to install an electric fish barrier at the Barrier Marsh site.
- Over 1.27 million pounds of common carp and buffalo have been removed from Lost Island Lake since 2008 reducing the common carp density from nearly 400 lbs./acre to 55 lbs./acre. The lake has shown substantial increases in water quality and habitat.

Water quality trends in Lost Island Lake. Water transparency (secchi) has increased and turbidity has decreased.



The final infrastructure component of the Lost Island Lake restoration project (at Barrier Marsh) was completed fall 2013. An electric fish barrier was added to the water control structure that will prevent



Constructed electric fish barrier in the Lost Island Lake watershed.

breeding common carp from reaching Blue-wing Marsh wetlands in the Lost Island Lake's watershed while allowing debris to pass during high water events.

The Barringer Slough and Blue Wing Marsh complexes have been brought back to pool elevation and water quality and habitat have greatly improved. Water quality, aquatic plant, and fisheries surveys and monitoring continued through 2015. A long time area resident reported, "Our family was here all last week, in the lake every day and the water was amazing! Haven't seen such clean water since I came with my grandpa in

the 50's! So happy to see the plant growth, too. Catching fish off the dock also. Looking forward to even better fishing in the fall!"

Meadow Lake (Adair County)

Meadow Lake is a 34-acre public owned lake located six miles north of Greenfield in Adair County. Constructed in 1963, the lake sits within a larger 320-acre fish and wildlife area owned and managed by the Iowa Department of Natural Resources to provide fishing, hunting, and other outdoor recreation activities for the public. Overall, Meadow Lake has provided good fishing for largemouth bass, bluegill, crappie, and channel catfish for over 40 years. The DNR listed Meadow Lake as impaired water in 2004 for algae and added impairment for turbidity in 2008. The presence of aesthetically objectionable blooms of algae and poor water transparency impair the primary contact recreational uses at the lake.



Meadow Lake exclusion fence demonstrates the effects of grass carp.

- DNR Lake Restoration and the Watershed Improvement Section, with design from NRCS, constructed an in-lake structure in the spring of 2010 at Meadow Lake to achieve sediment and phosphorous reduction from 236 acres of the watershed. In addition, two wetlands were constructed above Meadow Lake in 2010. The larger of the two wetlands is 14 surface acres. Removing Meadow Lake from the impaired waters list is the ultimate goal of the project.
- The effect of grass carp on aquatic vegetation by installing exclusion fencing was monitored in 2014 and 2015. Grass carp removal is ongoing.

Red Haw Lake (Lucas County)

Red Haw Lake is a 72 acre man-made reservoir in Southern Iowa with a 14:1 watershed to lake area ratio. Changing land use in the region has brought new attention to this lake to help preserve good water quality at this popular fishing destination.



- In 2001, a wetland and three sediment retention ponds were constructed within this watershed to improve and protect water quality.
- Recently IDALS performed a watershed assessment and identified priority gully areas.

The DNR initiated design for construction of six structures within the State park and repair of one private pond to control sediment and provide additional water quality benefits (see photo).

- Fall 2014 rains filled all ponds to capacity and fish stockings, including largemouth bass and bluegill, were completed in the fall of followed in each of the six ponds.

Twelve Mile Creek Lake (Union County)

Twelve Mile Lake is a 595 acre lake with a 17 ft. mean depth and 42 ft. max depth. This multi-use resource (Wildlife Management Area) has a 14,080 acre watershed and 24:1 acre watershed to lake ratio. During its peak in the late 90's Twelve Mile held nearly 30 fishing tournaments per year. By 2004, that number dropped to two. There were problems with common carp, decrease in water quality and drinking water required additional treatment.

Work began in 2005 to address improve water quality. Work included shoreline protection, terraces,

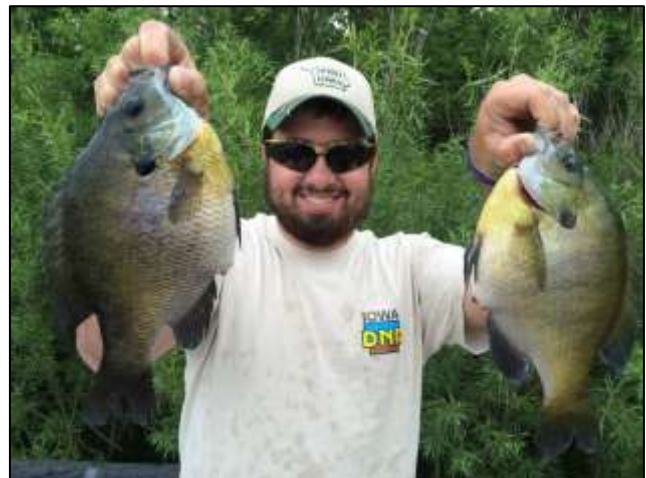


New 40-acre wetland structure above 12-Mile Creek Lake.

buffers and sediment structures placed in the watershed. DNR renovated the fishery and restocked the lake. Twelve Mile still has above average water quality compared to other IA lakes. Rooted vegetation has re-established in some areas with a recent trend is stable water quality. Twelve Mile continues to be in the top 1/3 in visitation. Over 50% of the anglers recently fishing 12-Mile are from > 50 miles away (twice what we normally see). Tournaments once again are scheduled throughout the open water season.

- A 40-acre wetland was constructed on the north end of 12-Mile Creek Lake in 2014 to retain nutrients and sediment. The project was delayed several times in 2014 due to record summer rainfall in southern Iowa.
- Lake Restoration Program and DNR Wildlife funds were used to help survey the 12-mile Creek Lake watershed and implement three grade control structures in the watershed. The wetland was constructed at a cost of \$447,291 (\$297,291 Lake Restoration / \$75,000 NAWCA / \$75,000 State Duck Stamp).
- 12-Mile Creek Lake has developed into a popular fishery since renovation. There are good numbers of 14-16 inch largemouth bass, and a few bass exceed 16 inches. Bluegills up to 10 inches are available to anglers at 12-Mile Creek Lake as well as moderate numbers of yellow perch and crappies in the 9-11 inch length range.

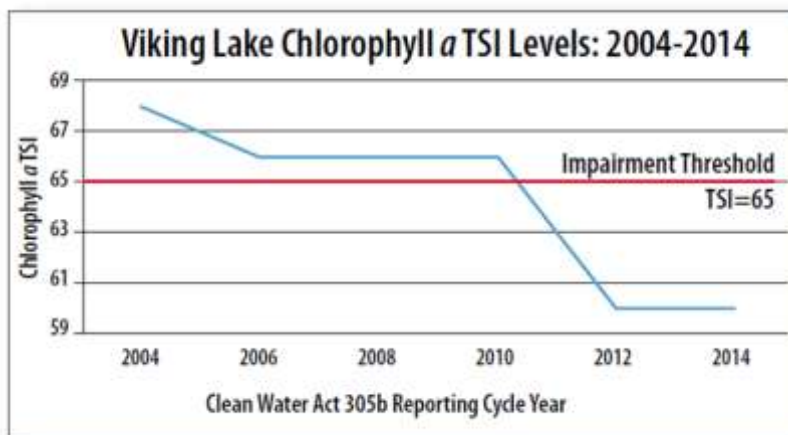
The wetland will further protect this valuable resource and add additional recreational opportunities for our constituents. Located at the upper end of permanent pool, the wetland is expected to remove and store sediment/nutrients in runoff and compliments continued work in the watershed, which is important to the goal to improve/maintain water quality for the main lake.



IDNR fisheries staff installed additional cedar tree brush piles during the winter of 2014-2015 to improve fish habitat and fishing success at Twelve Mile Creek Lake. Spring electrofishing indicated good numbers of largemouth bass up to 20 inches in length. Moderate numbers of bluegills were captured, but some very large (up to 11 inches; see photo) are available to anglers.

Viking Lake (Montgomery County)

Viking Lake is a 137-acre man-made lake, located within a 1,000-acre state park. Initially impounded in 1957 it has historically been an above-average fishery, however with the introduction of yellow bass approximately 10 years ago, the fishery has dramatically declined. Water quality at the lake has always been average, however following periods of heavy rainfall turbid water conditions could persist for up to two weeks, persistent algal have also been an issue at the lake. A watershed coordinator through the 319 program has implemented corrective measures within the watershed.



- IDNR staff identified twenty-two (22) areas near the lake, on or including portions of state property, as needing grade stabilization structures to control soil erosion and improve water quality. Construction of twenty sediment structures is complete.
- IDNR drained the lake after Labor Day (2006) and renovated the fishery to eliminate the problem yellow bass population.

- In addition, after lowering the lake, they repaired the dam gate, protected the shoreline, constructed jetties, deepened shoreline, and improved angler access and fish habitat.



Before



After

- Because of reduced algae levels and better water clarity (below the impairment threshold), DNR removed Viking Lake's algae impairment from Iowa's 2014 impaired waters list.

Lake Restoration Program (LRP) – Projects in Planning/Evaluation

George Wyth Lake (Black Hawk County)

George Wyth is a sand borrow-lake with relatively low overall fertility when compared to other Iowa Lakes. George Wyth's historic fishery was moderate to poor, due to relatively low productivity and a lack of aquatic vegetation. Water quality parameters in George Wyth Lake compare favorably to other Iowa lakes, due to a low watershed to lake ratio and relatively small portions of watershed in agricultural production.

- The IDNR Watershed Improvement Section completed a Water Quality Improvement Plan for George Wyth Lake in 2008 to address impairment due to high bacteria levels on the beach, with the primary cause for impairment identified as resident geese.
- Fisheries Biologists introduced aquatic macrophytes into George Wyth Lake in the fall of 2009 on an experimental basis. Wild Celery and Narrow-Leaved Pondweed were introduced into two enclosures designed to exclude aquatic herbivores. During a vegetation inventory completed on George Wyth Lake in 2010, IDNR staff found six species of submersed aquatic plants and two species of floating-leaved aquatic plants. Wild Celery planted during 2009 was found within enclosure structures and narrow-leaved pondweed planted in 2009 was found at multiple locations in the lake.
- During 2010, about 15% of the lake was covered with aquatic vegetation. George Wyth Lake was practically devoid of vegetation from 1988 – 2009, so biologists are optimistic that an aquatic plant community will improve water quality and fishery resources in the lake. Biologists are uncertain as to what caused the proliferation of vegetation in 2010, but the most likely explanation is that the flood of 2008 delivered sediment, seeds, and plant fragments to George Wyth Lake. During 2010, George Wyth Lake also experienced high water levels for much of the year due to persistent flood conditions on the nearby Cedar River. High water conditions and an increased abundance of aquatic plants promoted improved water clarity and improved overall water aesthetics at George Wyth Lake during 2010.
- During 2011, biologists identified seven species of submersed aquatic plants and two species of floating-leaved plants. Wild Celery was not found among the plants during 2011 and plant enclosures were removed from the lake. Unfortunately, brittle naiad (an aquatic nuisance species) was found in a small section of the George Wyth during 2011.
- The proliferation of vegetation in George Wyth during 2010-2011 was beneficial to the George Wyth Fishery due to increased fish habitat and improved water quality. Observational information from IDNR Parks and Fisheries staff suggest increased recreational use and improved fishery quality during 2011.
- George Wyth Lake experienced reduced lake water levels during 2012 resulting from drought conditions, and the quality and quantity of aquatic vegetation were much reduced from 2010-2011 levels. Fisheries personnel spot treated brittle naiad in an isolated (about 0.5 acre) section of lake to reduce the potential for spreading to additional areas of lake. The lake beach was reopened in the western basin of the lake during 2012. Fisheries personnel will be adding man-made fish habitat structures to the lake during 2013.
- George Wyth Lake water-levels were near “full-pool” for most of 2013 in response to high discharge in the nearby Cedar River (water levels in George Wyth are largely dependent upon groundwater recharge that varies with the water-level height on the Cedar River). Increased water volume led to

improved water clarity in George Wyth during 2013. The Iowa DNR Fisheries Bureau teamed with the Iowa DNR Parks Bureau and Cedar Valley Walleye Club to add 45 fish habitat structures into George Wyth Lake during July.

- DNR Fisheries Management partnered with DNR Fisheries Research and State Parks staff to introduce three species of aquatic plants into George Wyth Lake during July 14, 2015 at two locations in the lake basin (see photo above). These plantings included 72 water stargrass plugs, 79 largeleaf pondweed plugs, and 80 wild celery plugs propagated by Cold Springs Research staff. Enclosures were constructed from wire mesh and placed over approximately one-half of the plants to reduce damage from aquatic herbivores. This work was part of ongoing efforts to improve aquatic habitat and water quality in George Wyth Lake through establishment of a diverse aquatic plant community that covers 10% or more of the surface area of the lake.



Pine Lakes – Upper/Lower (Hardin County)

Upper and Lower Pine Lakes are man-made lakes located in Hardin County and serve as a popular camping and recreation destination for the area. The lakes are currently impaired to poor water quality related to low water clarity from algal and non-algal turbidity and bacteria.

Hardin County approached IDNR in 2014 to discuss the potential for construction of a large sediment control structure upstream up Upper Pine Lake. A bridge near the proposed construction site needed to be replaced the opportunity arose to raise the road and put in a large pond to prevent nutrients and sediment from entering Pine Lakes instead of re-building the bridge.

IDNR Engineering developed preliminary design plans and cost estimates and presented them to the County Conservation Board, the County Engineer, several other stakeholders, and one of the land owners in December 2015. More refined design plans and another meeting with additional land owners is planned for 2016.

Rock Creek Lake (Jasper County)

Rock Creek Lake is a 491-acre lake constructed in 1952. The lake has a watershed to lake area ratio of 54/1. Iowa State University, in a 2000 Diagnostic/Feasibility Study, indicated that over the last 50 years the lake has lost almost 40% of its lake water volume and 102 lake surface acres. Local efforts have accomplished some work in the watershed; however, local and state partners need a renewed effort to move this project forward. Continued watershed improvement projects have been a difficult “sell” to area landowners.

A fall 2008 technical work group meeting resulted in an outlined approach to meet the necessary reductions in sediment and nutrient delivery to Rock Creek Lake. It focused on dividing the total

watershed into larger sub-watershed segments, and then designing larger watershed structures that will require a higher government percentage contribution to put these water quality improvement practices in place. Several landowners had expressed interest in this concept; however, due to the inability to implement projects on private ground, the involved agencies did not grant the requested Watershed Project extension and the project contract expired December 31, 2009.

- During fiscal year 2009, landowners completed some small practices such as waterways and small basins in the Rock Creek Watershed as part of the funded Watershed Project. Implementation of these practices resulted in a sediment reduction of 1,439 tons/year and 750 acres protected from June 2008 to September 30, 2009.
- Work on the Rock Creek Watershed Project at this time is limited to five grade stabilization structures in the state park. The project coordinator had selected sites for the placement of three ponds and two large dry basins to address critical areas of gully erosion. The construction of these structures is completed and the IDNR has stocked three of the ponds.



New sediment basin at Rock Creek State Park.

- This challenging watershed will require other innovative concepts to significantly reduce sediments and nutrients from reaching Rock Creek Lake and to eventually allow us to move forward with the D/F studies lake restoration measures.
- IDNR met with the local friends group in the summer

of 2015 to discuss options for addressing the in-lake sedimentation and reducing sediment and nutrient inputs to the lake from the watershed. The need for a watershed management plan and considerable watershed work was discussed in order for in-lake to be considered.

Silver Lake (Delaware County)

Silver Lake is a small, natural lake enlarged by the construction of a dam. It has a 34-acre surface area lake and a lake ratio of 6.4/1. University of Northern Iowa completed a diagnostic feasibility study in 2001 and the IDNR completed a Water Quality Improvement Plan analysis in 2001. Lake depth maps and sediment borings indicated excessive lake sedimentation depths ranging from 0.5 to 4 feet. A lake watershed assessment conducted in 2001, documented areas of high phosphorus input in the watershed. The assessment also identified excessive manure application levels as a problem. NRCS continues to work with landowners in the watershed to reduce nutrient and sediment lake inputs.

- In 2001, an engineering firm evaluated dam integrity and leakage issues. The construction firm hired to repair the dam and eliminate dam safety issues completed the work fall of 2007 at a cost of

\$314,950. Lake water overflowed the Silver Lake spillway in April of 2008 following dam repair and wet weather conditions. According to local reports, that marked the first spillway overflow since 1993. Silver Lake has remained near full pool throughout 2008-2011, which indicates that dam repairs completed during 2007 were very effective.

- Submersed aquatic vegetation and water clarity have responded favorably to higher water volume and water levels that are more persistent. Vegetation was largely absent from Silver Lake during the 2006 and 2007 growing seasons and Secchi transparency commonly fell below 24 inches. Aquatic macrophytes (primarily coontail and narrow-leaved pondweed) were abundant during the summer of 2009, 2010, and 2011. Increased vegetation can pose a nuisance to recreational fishing, boating, and lake aesthetics; however, the dense vegetation coverage promotes improved water clarity and reduces the abundance of free-floating algae.
- IDNR completed a Water Quality Improvement Plan for Silver Lake in the fall of 2008 and this study highlighted watershed areas responsible for primary phosphorus delivery. The goal is to form local action committees to address watershed inputs. Following watershed improvements that reduce sediment delivery and phosphorus inputs, the community and biologists are hoping to remove phosphorus-rich sediments from Silver Lake to help reduce problems associated with internal phosphorus loading.
- During 2010, members of the Delhi Community formed a small community-led workgroup. This workgroup held two meetings during the 3rd quarter of 2010 to discuss options for watershed improvement and in-lake water quality improvement. Activity of this group lost momentum during 2011.
- Silver Lake suffered a moderate winterkill during the severe winter of 2010-2011, which effectively eliminated largemouth bass from the system and reduced the bluegill population. IDNR Fisheries restocked Largemouth Bass in June 2011 and the bluegill have recovered favorably during the 2011 growing season. Silver Lake had reduced fishing pressure during 2011 because of the recent fish kill, but fishery use is expected to increase substantially during 2012.
- Recovery of the fishery following the severe winterkill of 2010-2011 has proceeded within expectations. Largemouth bass in the 8-10 inch size are now common and the lake contains high numbers of 3-6 inch bluegills and 5-7 inch black crappie with a few larger individuals present. Silver Lake is approximately 6-feet below crest following the drought of 2012 and significant rain will be required to reach full pool. Barring a severe winter during 2012-2013, it is expected that Silver Lake will provide good opportunities for largemouth bass and bluegill during 2013. Watershed improvement work is still needed and a small group of local residents remains dedicated to improving the resource.
- Fish populations in Silver Lake continue to thrive following the winterkill event that occurred during 2010-2011. Largemouth Bass in the 8-10 inch size are now common in Silver Lake with some individuals up to 14 inches. High numbers of 4-7 inch bluegill are present and these fish are expected to provide good winter fishing opportunities during the 2013-2014 ice season. Anglers continually report good catches of bass and bluegill, as well as modest catches of northern pike in the 20-30 inch size range. Observations of much increased fishing pressure were reported by County Conservation Board staff, Iowa DNR staff, and Delhi residents during summer 2013. A new boat ramp is planned for Silver Lake during spring 2014. Silver Lake was about 18-inches below crest during fall 2013 despite a late summer drought and this continues to support that dam repairs made during 2007 have greatly improved water-level stability.

- Silver Lake suffered a winter-kill event during the winter of 2013-2014 that significantly reduced the abundance of largemouth bass and bluegill in the Lake. Stocking efforts during 2014 and 2015 have largely restored the abundance of largemouth bass and bluegills, but the abundance of large sizes of these species remains below fishery management goals.



- A new boat ramp and parking area were completed at Silver Lake during April 2015 and a new dock was placed during June 2015 to improve access amenities.

New boat ramp and dock at Silver Lake, Delaware County June 2015.

- DNR Fisheries staff met with Delaware County USDA-NRCS staff and Delaware County SWCD staff during February 2015 to discuss watershed improvement on agricultural lands within the Silver Lake watershed. Delaware County SWCD staff made personal contacts with primary agricultural landowners during March 2015 and formulated nutrient reduction strategies that include implementation of grassed waterways, perennial vegetation plantings, no-till farming, and P-based nutrient management. Implementation of new practices began during the 2016 crop year and they are expected to result in significant reduction of phosphorus delivered

to Silver Lake in coming years. Additional watershed improvement planning is a priority for winter of 2015-2016 including contact with primary urban landowners.

Silver Lake (Palo Alto County)

The Silver Lake Protective Association was successful in 2012 at acquiring local grant money to pursue survey, design, and engineering of a fish barrier on the existing outlet structure and determining the feasibility of using the existing drawdown structure. The initial design is complete but implementation is on-hold to examine how the barrier will fit into the overall improvement plan.

In August 2013, the lake association met with Fisheries, Wildlife, and Lake Restoration staff. The meeting provided the association with a framework for moving towards a restoration project. An ongoing diagnostic and feasibility study of Silver Lake and its watershed was initiated in 2014 and is being conducted by Iowa State University. The Silver Lake Improvement and Protection Association is providing \$22,000 during each of the two years of the study. Iowa State University hosted a public meeting in Ayrshire in July 2014 to discuss the preliminary and anticipated results of the study.

A well-attended mid-contract advisory committee meeting was held in 2015. ISU presented a mid-project summary to project stakeholders and members of the public interested in work at the lake. The group will meet again at the completion of the feasibility study, with a final report due to IDNR in March 2016.

Swan Lake (Carroll County)

DNR fisheries staff has been working closely with the Carroll CCB in efforts to re-establish emergent vegetation around the perimeter of Swan Lake. Siphoning and pumping efforts have taken the lake 4 feet below the crest of the spillway, which was the goal of the draw down project. There was a vegetative response to the draw down. As expected, it was mostly annuals. The draw-down occurred throughout the 2013 season in order to establish a good stand of perennial vegetation, such as bulrush and cattails.

DNR monitored Swan Lake throughout the summer of 2013 and observed a very good vegetative response of annual species, such as smartweed and yellow nut sedge. DNR also found bulrush and some cattail in several areas. In addition, we attempted an experimental removal of grass carp with a commercial angler using trammel nets. Through our efforts were removed 40 grass carp from Swan Lake. Three hundred grass carp were originally stocked in Swan Lake since the renovation in 2004 and none have been stocked since. Due to the success of removing grass carp, we are planning to attempt another removal effort through the ice when the grass carp cannot jump the nets. The Carroll CCB is paying for the services of the commercial angler. Although we have winter aeration there, we are still going to bring some water back into the lake via well/pipeline. The Carroll CCB is also paying for the cost of pumping in water and running aeration.



Emergent vegetation growing in the basin of Swan Lake during the partial draw down.

Wetland Restoration

The Carroll County Conservation Board was awarded a WIRB grant, supplemented with \$7,000 in Lake Restoration Program funds, to construct a 4-acre wetland in the watershed of Swan Lake. The Carroll County Conservation Board completed the four-acre wetland in the watershed of Swan Lake in 2014. The wetland is an instrumental part of our Swan Lake Watershed Management Plan and its construction will be critical to improving water quality by reducing

the amount of sediment/phosphorus that enters the lake from the watershed.

Water Level Management

Swan Lake was partially drawn down in 2012 and 2013 in an effort to establish vegetation around the perimeter of the lake and improve water quality. The draw down was achieved using a pump purchased by the Lake Restoration program and Carroll CCB dollars paying for the fuel and oil. The lake was allowed to refill in 2014 and emergent aquatic vegetation has started to grow in the shallow areas around the perimeter of the lake. Some submergent vegetation was also observed. Aquatic vegetation established in 2015; however, algae blooms over the hot summer months were common, resulting in a fish kill in August of 2015 due to low oxygen levels from an intense algae bloom. Continuing to establish aquatic vegetation in the lake will help mitigate these swings in oxygen levels due to algae blooms and

limit algae growth as plants use available phosphorus in the lake, thus preventing noxious algae blooms from establishing.

Twin Lakes – North/South (Calhoun County)

Local DNR fisheries and wildlife biologists met with the Twin Lakes Restoration Association (TLRA) to discuss water quality issues in the lake system. Local DNR staff fielded a number of calls throughout 2011 in regards to water quality issues and potential projects at both lakes. The TLRA invited local biologists to attend a meeting and provide information regarding water quality projects.

- Biologists explained that the best way to start a water quality project is to conduct a comprehensive Diagnostic Feasibility Study on both lake systems. The TLRA has sent a letter to the Director of the DNR requesting that the Twin Lakes System be included in the Lakes Restoration Program budget to fund a DF Study.
- The potential for a successful restoration project on the Twin Lakes System is high. North Twin Lake has an average depth of 8.7 feet, which is relatively deep compared to other natural lakes in the region. Additionally, both North and South Twin Lakes have a relatively small watershed to lake ratios and although the land surrounding the two lakes is primarily in row crop production, the slope of the land is low.

DNR fisheries staff attended a meeting with the North Twin Lake Restoration Association and Senator Beall in March 2013. The purpose of the meeting was for DNR staff to provide information on what is involved with a Diagnostic Feasibility Study, how the study is conducted, and what to expect if such a study were to be carried out. Senator Beall provided information on legislative and budgetary issues.

- The DNR signed a \$209,854 contract with Iowa State University to carry out a DF Study, which started in October. The DNR intends to utilize the information gathered and analyzed in this Contract to plan and implement lake and watershed improvement efforts on North and South Twin Lakes.
- The Twin Lakes Restoration Association has pledged \$43,000 to help DNR Lakes Restoration fund the DF Study. In September 2013, DNR fisheries staff and members of the TLRA met with the Calhoun County Board of Supervisors to discuss a partnership. The Board of Supervisors pledged to contribute \$20,000 to lessen the burden of the TLRA's responsibility for providing match money. DNR fisheries staff and members of the TLRA also met with the Calhoun SWCD to discuss the same issues. The SWCD pledged to contribute \$1,000 to the DF Study. The largest contribution from the SWCD will most likely come in the form of grant applications and employing a watershed coordinator as the project progresses.
- In November 2013, Iowa State University and the DNR held a public meeting at North Twin Lake to present and discuss the DF Study that will be carried out on North and South Twin Lakes. Approximately 40 people attended.

ISU is actively collecting samples for the DF Study for the Twin Lakes. DNR fisheries staff presented at the annual Twin Lakes Restoration Association meeting and provided an update on the DF Study in June 2014. DNR fisheries, lake restoration, and ISU met with the local steering committee to provide an update of the DF Study and answer questions in August 2014. DNR fisheries attended and presented at a tour of the Twin Lakes watershed in November 2014. The purpose of the tour was to highlight some of

the best management practices already installed in the watershed and discuss the future of the lake restoration project.

Iowa State University finished field sampling work in October and has completed a rough draft of the diagnostic portion of the DF Study. ISU, local DNR managers, and the local steering committee (comprised of local stakeholders) met on November 24th to discuss the results of the study and share ideas on developing the feasibility portion of the report. A public meeting is expected to be held in early January 2016 to present the final report to the public and discuss the next steps to improving the water quality in the Twin Lakes system.

Lake Restoration Program - Shallow Lakes Management Initiative

Shallow lake management has always been a challenge in Iowa and around the world. Shallow lakes are scattered throughout Northwest Iowa and, in most of these lakes water quality is less than desired. In fact, most of these lakes are turbid, algae-dominated systems with little to no vegetation, and poor sport fisheries comprised mostly of common carp (*Cyprinus carpio*), and black bullheads (*Ameiurus melas*). Successful restorations of deeper lakes have historically focused on reducing nutrient inputs by repairing the watershed and/or removing phosphorus-laden sediments from the lake. Successful shallow lake management strategies require intensive in-lake management strategies that can immediately flip the basin from the turbid-water state to the clean-water state, and long-term watershed protection efforts that help maintain clean water over time.

Shallow lakes differ substantially from deeper lakes in many respects. Shallow lakes usually exist in either of two alternative stable trophic states with or without any change in the nutrient budget of the lake. These lakes can exist as very turbid, algae-dominated systems with little to no vegetation, or as clear water, macrophyte dominated systems. In shallow lakes, the benthivorous and planktivorous fishes along with wind and wave action and in some cases heavy boating traffic can perpetuate the algae dominated system.

Severe blue green algae blooms are capable of producing during warm weather in unhealthy shallow lakes.

By controlling or removing the factors perpetuating the algae dominated turbid system, it is possible to "flip" the system into a clear water macrophyte dominated system. The positive impacts of emergent and submergent vegetation on water quality are due to several factors. Rooted vegetation prevents resuspension of sediments into the water column by solidifying bottom sediments and suppressing wind and wave action. Rooted plants provide habitat for periphyton and zooplankton and fish species commonly found in clear water lakes. Rooted vegetation also ties up nutrients making them unavailable for algae. Some plants also release allelopathic substances into the water suppressing algae growth. Many of these mechanisms are difficult to assess and vary among water bodies; however, their combined effect stabilizes the clear water trophic state. Both the clear water macrophyte state and the algae dominated state are stable, and it takes a major perturbation to move from one state to another. Three methods that show great promise to cause the shift from the turbid to the clear water state are benthivorous fish control, heavy piscivore stockings (to control both benthivorous and planktivorous

fishes), and water level draw downs. The goal of this project is to develop tools that managers can use to shift and maintain shallow lakes in a clear water state.

Many natural Lakes in Northwest Iowa are characterized as these shallow, windswept systems that exhibit poor water quality. Significant watershed changes and the introduction of common carp in the late 1800's have forever made management of these water bodies a challenge. Through work accomplished on the projects listed below, great strides have been made in our understanding of these systems. These ground breaking projects in Iowa will undoubtedly lead to others as the health to these unique water bodies is restored. Success is also being measured in public education and outreach, communities and user groups are coming together to make these projects truly successful demonstration models for improving not only water quality, but fostering partnerships for the long-term active management required to maintain the health of these lakes.

Good water quality and healthy aquatic plant communities can become evident through shallow lake improvement projects

Iowa DNR's Wildlife and Fisheries Bureaus in cooperation with Ducks Unlimited have established a list of shallow lakes prioritized renovated. The current focus of the Lake Restoration Program is on shallow lakes that support both fishing and wildlife benefits. In addition, there is an emphasis on shallow systems above important natural lakes.

Shallow Lakes Projects:

Pickereel Lake (Buena Vista County)

Pickereel Lake, located in extreme NE Buena Vista County, is a 170-acre basin that suffered from the same problems as most other shallow lake basins in the upper Midwest; poor water quality due to an intensively cultivated watershed, an overabundance of rough fish, and a lack of beneficial aquatic plants. Even with poor water quality, walleyes have surprisingly been able to reproduce in Pickereel Lake. Project partners initiated intensive in-lake management to enhance water quality, fish and wildlife habitat in Pickereel Lake. In addition, they will continue to work long-term throughout the watershed to ensure that soil, fertilizers, and pesticides stay on the uplands. In-lake actions included installing a new water control structure and fish barrier on the lake's outlet and enhancing existing draw down channels in the lake and downstream of the new water control structure. Once this infrastructure was in place, the DNR temporarily drained the lake to allow for the elimination of problem fish, the consolidation of bottom sediments, and the establishment of beneficial aquatic plants.

Pickereel Lake was drained in the late winter/early spring of 2011 and now has gone through its second year of a draw down since the project's inception. No boards were put in the stop log structure to hold water in 2012 and good stands of perennial emergent vegetation were established. Some attempts were made to hold water in Pickereel Lake in 2013, but water levels are quite low. Even with low water levels, 42,000 yellow perch were stocked into Pickereel Lake in July 2013 in the hope to get a start on the fishery going into 2014. DNR fisheries staff has been monitoring water levels at Pickereel Lake in 2014 and have assisted with stocking adult perch and fertilized perch eggs.

Rice Lake (Winnebago County)

Local interest has developed for shallow lakes management on Rice Lake. The fishery has declined and the water quality is currently poor. DNR held public meetings to discuss shallow lakes management with the community. The public meetings held in 2013 had overwhelming support for shallow lakes management.

The lake was drawn down 4 feet in late 2013 to facilitate renovation of the fishery and promote aquatic vegetation growth. The DNR applied rotenone through the ice during the winter of 2013/2014. Vegetation growth responded well and water levels will be brought up slowly in the spring of 2014. In addition, fish stockings were initiated in June 2014. Fish stocking included yellow perch ribbons and adults, walleye fry and fingerlings, largemouth bass fingerlings, bluegill fingerlings. The lake remained about 20 inches low going into winter 2014.

In 2015 the lake level returned to crest. Fish stockings continued in 2015 with the fishery developing nicely. Water quality remained good in 2015. The aquatic plant community remains relatively stable. Construction of a new water control structure will start late 2015 and continue into 2016.

***Aerial photo of Rice Lake taken
October 2015.***

Photo by Jones



Sands Timber Lake (Taylor County)

Sands Timber Lake (Blockton Reservoir) is a man-made 60 acre lake located in Taylor County that is currently listed as impaired due to the impacts of common carp on the lake. Carp activity has caused water clarity issues due to sediment re-suspension.



A 19-acre wetland was constructed in the west arm of the lake in 2015 (see photos) to help settle-out sediment as it enters the lake from the watershed. This wetland is the second wetland built at the lake, with the first wetland (a 16-acre wetland) constructed in the north arm of the lake in 2013.

In-lake improvements are also needed to restore water quality at Sands Timber Lake. Shoreline

deepening was completed in 2014 and a fish mound and cedar tree brush piles were installed to create better fish habitat within the lake. Finally, the fishery is scheduled for renovation in December of 2015. This effort will work to eliminate the carp population from the lake and help improve water quality. Restocking is slated to begin in spring of 2016.

Silver Lake (Worth)

DNR conducted shallow lakes restoration work at Silver Lake starting in 2011 in response to poor water quality. The plan was to replace the current water control structure, dig a channel in the lakebed to aid in draining the basin, and renovate the fishery. The benefits will be improved water quality, establishment of an aquatic plant community, and a restored fishery.

Silver Lake water control structure was replaced in 2011/2012 and a drawdown was conducted in 2012 for vegetation establishment. Three feet of stop logs were placed in new structure in August 2012 to begin re-filling the lake. ***The plant community response has been good. There is a good stand of bulrush establishing with several other species of aquatic plants coming as well.***

Fish stockings of yellow perch and bluegill occurred in 2013. However, that fall the DNR started getting reports from the public that carp were in the lake. A DNR electrofishing survey confirmed that carp were present in the system. The Conservation Officer also collected some carp with a mud motor after the electrofishing survey. The only gamefish collected was one perch.

A public meeting will be held and explain the situation. The opinion of the DNR is that a 7-inch rain event in late May either topped the barrier or allowed a few fish to jump the barrier and that required a modification of the barrier to address vulnerable spots for fish migration.

The management strategy was to lower the lake after freeze up and try to winterkill the carp. Rotenone was added under the ice to get a complete kill. The lake was then be boarded up to near crest to capture as much as the spring 2014 as possible. Spring 2014 fish stocking included yellow perch ribbons and adults, largemouth bass fingerlings, and bluegill fingerlings.

In 2015, additional material was added to the water control structure berm. The dirt and rock work was needed to stop water from leaking across the berm during high water events and prevent any possibility of carp entering the lake. The aquatic plant coverage and density declined in 2015, especially the emergent cattail and bulrush growth.

Silver Lake (Worth Co.) water control structure berm construction 2015.

Photo by Herrick



Trumbull Lake (Clay County)

One of Iowa's larger shallow lakes was the focus of a water quality improvement project that was initiated from 2012 drought conditions. The 1,200-acre Trumbull Lake and its 1,000 acres of connected marshes, in Clay County, are nearly dry which is unusual for the shallow lakes system that receives water from a nearly 50,000-acre watershed.

The Iowa Department of Natural Resources presented its plan to improve the lake during a meeting October 2012 in Okoboji. "Trumbull has an enormous watershed so we need to take advantage of this opportunity that Mother Nature is granting us to recharge the marshes and improve the lake by getting plants to return and eliminate the carp," said Mike Hawkins, fisheries biologist with the Iowa Department of Natural Resources. Hawkins said restoration plans shifted gears when it became apparent that the summer was going to be a drought for the record books. What began as a partial drawdown of 22 inches last spring, ended with, essentially, a dry lake.



Aerial photo of Trumbull Lake taken in October showing the increase in emergent aquatic plants following the drawdown.

"This is a blessing, in a good way," said Bryan Hellyer, wildlife biologist for the DNR. "While things didn't go as planned with the drawdown, we now have an opportunity to reset the lake-marsh system and go from a shallow lake with murky water and no vegetation to one that benefits waterfowl, shorebirds and all kinds of wetland wildlife with emergent and submergent

vegetation. That's exciting."

Hawkins said they will dig an existing channel to keep the lake water free as much as possible next spring to allow plants to germinate and grow on the lakebed. "We have a small window of opportunity in May and June to get these plants to germinate so we plan to begin digging the channel soon after this meeting," Hawkins said. Trumbull Lake was drawn down during the summer and fall of 2012. Following a public meeting in October of 2012, Trumbull Lake was drawn down throughout 2013 and the watershed renovated through low water and rotenone application. The restoration plan included stocking yellow perch and northern pike in the spring of 2014.

"Trumbull Lake has been in a dismal state for years. It has a history of some boom and bust cycle of fishing, but mostly poor fishing and poor water quality. What this project should do is improve the water quality and make the fishery more consistent," Hawkins said. "If this



is your spot to hunt or fish, we understand how this can be disappointing, but if all goes as planned, Trumbull Lake will dramatically change for the better for wildlife and fishing for quite a few years,” Hellyer said. In addition, it will be carp-free for the first time since carp were introduced 100 years ago. ***Photo of the Trumbull Lake outlet structure. Aquatic plants can be seen in the lake.***

Trumbull Lake was refilled in June 2014 by heavy rains. Aquatic habitat and water quality have improved. Yellow perch were stocked in Trumbull Lake in 2014 and northern pike were stocked in 2015.

Virgin Lake (Palo Alto County)

Virgin Lake is a unique 220-acre basin in western Palo Alto County that features a highly diverse shoreline, back bays, peninsulas, and islands. Like other shallow lakes in Iowa and the upper Midwest, it has become unhealthy due to intensive agriculture in its watershed and an overabundance of rough fish. Together, these and other factors have resulted in turbid water in the lake and the subsequent loss of the beneficial aquatic plants needed to sustain clean water and provide habitat for sport fish and aquatic wildlife. Project partners, including DNR and DU plan to improve the lake by riding the lake of problems fish species, restoring aquatic plants, and stocking quality game fish.

The lake was drained fall 2011 and was drawn down completely during early 2012. Aquatic plants have germinated over the entire basin. Yellow perch eggs were stocked in April 2014. Water levels recovered very slowly because of drought conditions in 2013. Approximately 20,000 yellow perch fingerlings from

Genoa National Fish Hatchery were stocked in August 2014. Walleye were stocked in Virgin in 2015.



Drought conditions in 2012 and 2013 were unexpected and provided an opportunity for both aquatic and terrestrial vegetation to become very thick in the lakebed. This situation should improve with water back in the lake. The lake opened up slightly in 2015.

Aerial photo of Virgin Lake taken October of 2014. Photo by Zenner

Walnut Creek Marsh (Ringgold County)

Walnut Creek Marsh is a wetland located in Ringgold County, west of Mount Ayr. The wetland has experienced problems with siltation that have impacted water quality and the fishery at the wetland. Restoration activities are scheduled to begin in 2016. A contract for channel deepening was approved by the Natural Resource Commission in December of 2015. As a part of the restoration efforts, A 25 feet wide, 4 foot deep channel will be excavated along the dam to increase the maximum depth of this waterbody to historical conditions. The current average depth of the marsh at normal pool is 2 feet, but

historically it was between 4 feet and 6 feet. The increased depth will improve water quality conditions during the summer and winter when temperature and oxygen conditions cause increased stress on the fish population. A channel from the boat ramp to the main lake will also be excavated to allow boaters to access the main lake without concern of damaging their boats and motors on sunken tree stumps and other debris.

Lake Restoration Program – Special Projects

Lake Delhi (Delaware County)

Lake Delhi is a 450-acre on-stream impoundment located on the Maquoketa River in Delaware County.

2010 Flood Event

The Lake Delhi Dam is located southwest of the city of Delhi, Iowa and forms an impoundment on the Maquoketa River. During the flood event of July 23-24, 2010 a portion of the southern earthen embankment of the privately owned dam was breached and eroded by the flood and the concrete spillway's gates were damaged. Floodwaters also infiltrated and seeped through a section of the northern embankment.

When the Delhi Dam breached during high water in July, it created a waterfall from the higher situated bed of Lake Delhi that had been receiving silt for 80 years, to the river below. The force of the falling water ate away at the silt, moving the waterfall gradually upriver and causing tremendous loads of silt to be released downstream. Any areas this head cut passed were highly susceptible to rapid channel widening during high water, which released sediments even more rapidly. It was estimated that hundreds of thousands of tons of silt had been released into the river downstream creating maintenance problems, recreational problems and threats to aquatic life.

Iowa Governor Chet Culver issued a disaster declaration in October 2010 charging the Iowa Department of Natural Resources to stabilize the Maquoketa River's eroding lakebed. Under direction of the disaster declaration, the DNR Policy and Coordination Bureau submitted a project request to develop and implement an engineering project to stabilize the head cut. The DNR also collaborated with the Lake Delhi Recreation Association with assistance from the Natural Resources Conservation Service to complete the project. The resulting project was construction of two riffle areas. One initiative sought to head off the lakebed erosion at the County Road X29 bridge. To stop the erosion, the project called for removing much of the accumulated silt and adding rock riffles to the bed. Much of the work took place under water. The other work, which took place at the Delhi Dam and cleaned up breach site, used loose rock to shore up the remaining portion of the dam and created a stilling pool upstream of the breach area. The two projects in the Maquoketa River designed to stabilize the former bed of Lake Delhi are now complete.

Feasibility Study for Dam Restoration

The DNR entered into a Cooperative Agreement with the Lake Delhi Combined Recreational Facility and Water Quality District to fund a preconstruction dam restoration study as directed under House File 648. The District entered into a Cooperative Agreement to retain consulting services for analysis of conditions for reconstruction of Lake Delhi Dam; preparation of regulatory documentation for the reconstruction of

Lake Delhi Dam; preparation of construction documents for the reconstruction of Lake Delhi Dam; bidding services and engineering services during construction.

Funding for this project was appropriated during the 2011 legislative session per HF 648.

“Of the amount appropriated in this lettered paragraph, \$350,000 shall be allocated to a county with a population between seventeen thousand seven hundred and seventeen thousand eight hundred as determined by the 2010 federal census, for a lake with public access that has the support of a benefited lake district. The allocated moneys shall be used for purposes of completing a preconstruction dam restoration study that would include a geotechnical evaluation, hydrological studies, restoration alternatives and construction specifications. The preconstruction dam study shall be filed with the general assembly upon completion”. This project is not typical of our current lake restoration process; however, it was supported through legislative direction. To-date, all available funds have been billed for this project.

Restoration of Lake Delhi Dam

The Iowa legislature appropriated a total of \$5.0 million (\$2.5 M from FY13 and \$2.5M from FY14) from the Rebuild Iowa Infrastructure Fund for the restoration and reconstruction of Lake Delhi dam under SF 2316 of the 84th General Assembly, with administration of funding was given to the DNR. Funding for restoration and reconstruction of the lake and dam is being handled through a grant from the DNR to the Lake Delhi Combined Recreational and Water Quality District (the District) and covers architectural and engineering design costs, including all related survey; acquisition of real estate and property rights; construction management costs; and construction labor and material costs.

As of November 30, 2015, the District has requested and been re-imbursed all of the appropriated \$5.0 million in funding for re-payment of eligible expenses.

Phase 1 work by Lunda began work in April 2014. Other than the setback in June with the flooding, the project benefited from ideal weather the rest of the construction season. Work completed by Lunda included all concrete patches on the main structure; a new south pier was poured and steel forms removed that will be reused on the new south pier; rock bolt anchoring was completed and backfilled; and electrical demolition took place inside the powerhouse structure. Work involved removing concrete at the south Abutment and placing rebar and forms at North and South Abutments for new Gate and Stop Log Guides. The south downstream Wing Wall rehab patches were identified, deteriorated concrete removed, new rebar and forms placed and new concrete poured. Lunda removed some of the Sheet Pile Shoring at the NW corner of the Powerhouse section of the dam. Work was completed in a manner to coordinate with the new Phase 2 contractor for the second part of the work to restore Lake Delhi in 2015.

Below update is taken from the Lake Delhi Voice October/November 2015 Newsletter

Phase 2 work is taking place on the south side of the river. The main scope of Phase 2 work is to rebuild the earthen dike as well as construct a new state of the art structure is getting a face lift with a new concrete surface. The work in the lower middle of the picture is subsurface preparation for the new stilling basin floor that will extend between the two new walls.

The new spillway and earthen dike will be in excess of 40 feet high when complete. Currently General Constructors Inc. has 2 1/2 crews working 6 days per week to finish the work. Two complete crews

forming and placing concrete and a smaller crew of iron workers assembling rebar configurations to stay ahead of the foreign work.

Weather has been very favorable for construction in September and first part of October — we are hoping for more of the same for balance of October and November. We are on the home stretch of completing the construction of the new Lake Delhi Dam. Construction work began in April of 2014 and has continued without interruption with an expected completion in late fall 2015. At that point, weather permitting; the lake will be ready for filling.

Under current program guidelines Lake Delhi is not on the list of significant public lakes ranked for program consideration. Specifically, Lake Delhi does not meet the criteria of being maintained principally for public use and it does not have a watershed to lake surface area ratio of less than 200:1.

For the purpose of Iowa's Lake Restoration Program, "significant, publicly-owned lakes" are defined as those publicly-owned lakes that meet all of the following criteria:

- are maintained principally for public use;
- are multi use systems capable of supporting a viable sport fishery and recreational opportunities;
- have a surface water area of at least 10 acres;
- have a watershed to lake surface area ratio of less than 200:1;
- are not federal flood control impoundments (exception is Rathbun Reservoir due to a watershed to lake surface area ratio that is less than 200:1); and
- are not lakes used solely as water supply reservoirs.

Lake Delhi has a huge watershed draining into it (220,000 acres) and technically, with a watershed-to-lake ratio of 488/1, is classified as an on-stream impoundment rather than a lake. In addition, Lake Delhi would not rank well relative to other Iowa lakes in terms of feasibility of restoration (can we be successful). With such a large watershed, it is unlikely that lake improvements can be sustainable. The DNR Lake Restoration Program, following the legislative plan, is involved in a number of lake restoration projects around the state and none of the current or past projects has such large watershed-to-surface acreage lake ratios.

Lake Restoration Program – Other Program Activities

Ambient Lake Monitoring

The IDNR invests in monitoring the status and trends of many of Iowa's publicly owned lakes. Data are collected three times each growing season (once in early summer/late spring, once in mid-summer, and once on late summer/early fall) to better understand water quality at Iowa's Lakes.

The program was created in 2000 based on lake surveys completed by Bachmann in the late 1970s and early 1990s. Currently the program includes 138 lakes throughout the state; they are monitored for chemical, physical, and biological parameter. Data are used to inform stakeholders, determine the impairment status of lakes in the state, establish water quality trends, and prioritize lakes for restoration. All data collected are made available to the public through Iowa STORET (online database)

or through the Iowa Lake Information System and Mini-Report (housed at Iowa State University) at the following web address:

<http://limnology.eeob.iastate.edu/lakereport/>

The Lakes Restoration Program (LRP) has served as a partner in this monitoring program since its inception in 2000. Currently, the LRP funds a 40% cost share for monitoring program with the Water Quality Monitoring and Assessment Section in the Water Quality Bureau. The current contract for monitoring contract for 2014-2016 is \$522, 131 and LRP's costs are \$208,852. Data collected as a part of this program are currently being used to inform restoration decisions and feed the water quality portion of the lake restoration prioritization process (see below). Water quality data collected through this program are also used in conjunction with the CARD survey data (shown above) to determine how Iowans value/perceive water quality and how water quality influences lake visitation and spending rates.

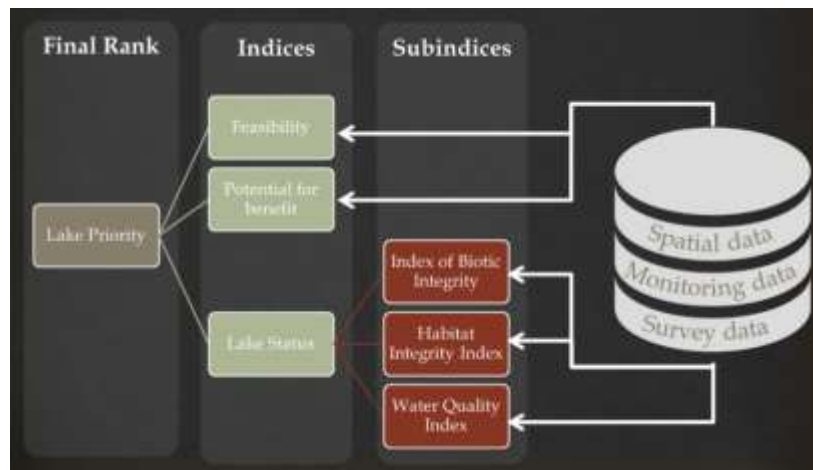
Lake Prioritization Process

The Lake Restoration Program initially ranked 127 public lakes for lake restoration priorities in 2006. A group of thirty-five lakes, considered highest priority for restoration, was established and served as a starting point for identifying potential lake restoration projects. Ranking indices used lake water quality data and watershed characteristics to create groups of good, fair, or poor lakes and watersheds. The department used these descriptions to categorize lakes into management action groups.

The initial list of thirty-five significant publicly-owned lakes was prioritized for funding based on the feasibility of each lake for restoration and the use or potential use of the lake, if restored. The list included lake projects under active development that the department recommended be given priority for funding so long as progress toward completion of the projects remained consistent with the goals of the program. Additional lakes have since been added to the priority list after communities have successfully petitioned the director of the department or were prioritized by the department based on the feasibility of the lake for restoration and the use or potential use of the lake, if restored.

DNR reviews projects annually to determine which lakes should proceed with lake restoration. Until watershed best management practices protect the lake, restoration work cannot move forward, therefore lakes with well-documented watershed protections are the best candidates for restoration. Local commitment and community support is another key component in determining which lakes receive funding for restoration.

The LRP uses cost benefit analysis to determine how Iowans will benefit from potential restoration projects. We also work to identify non-economic benefits to people and our natural resources when considering new projects for restoration. Computing and documenting the economic benefits, recreation benefits, health benefits, and natural resource/environmental benefits of lake improvements will be a great asset to the lake restoration process. Thus, in 2013, the program began to develop new metrics to rank our significant publically owned lakes in terms of their potential for meeting program goals that will allow us to make more informed decisions regarding where restorations dollars will be most beneficial to the public. The conceptual framework for this process is provided in the graphic below:



A water quality index for Iowa's lakes was developed in 2015 to examine how Iowa lakes compare to one another using several key water quality parameters collected through the Ambient Lake Monitoring Program. This index allows the LRP to compare lakes in a consistent framework and prioritize those most in need of better water quality.

The feasibility index was also updated in 2015 using updated RUSLE (Revised Universal Soil Loss Equation) calculations based on recent watershed land use data and the watershed to lake surface area ratio. This index allows the LRP to better understand how likely a watershed and in-lake restoration project is to succeed if implemented.

Finally, the potential for benefit index was updated using recently collected CARD survey data that evaluated the visitation rates at each lake and the economic impact of each lake, so the LRP can prioritize lakes that will have a high impact on Iowans and provide quality recreational experiences at lakes around the state.

Future work in LRP prioritization process includes the development and revision of additional indices. Additional work will incorporate new geographic data collected for each watershed, Creel survey data collected at our lakes, habitat and biological data collected at our lakes, and other metrics that will help us identify future candidate lakes for funding.

Social/Economic Impacts of Lakes in Iowa (CARD Survey)

The Iowa Lakes Valuation Project (CARD Survey) is an ongoing economic study funded by the Lake Restoration Program that identifies where and how frequently Iowans use their lakes and the value of good water quality at those lakes. The survey was first conducted in 2002 through the Center for Agricultural and Rural Development (CARD) at Iowa State University, coupling survey data collected from Iowans across the state and water quality data collected through the Ambient Lake Monitoring Program. Since the program's inception, the survey has been carried out in 2002, 2003, 2004, 2005, 2009, and 2014, and is jointly funded by the Iowa DNR LRP and the U.S. Environmental Protection Agency. More information on the survey and data collected through the survey can be found at:

<http://www.card.iastate.edu/lakes/>.

The 2014 survey was sent to nearly 7000 Iowa households, with a 52% response rate. Respondents were asked about the number of trips and which lakes they made trips to in 2014. They were also asked about the activities they engaged in while visiting the 139 lakes included in the survey. Additionally, they were asked questions about their perception of water quality at the lakes they visited and pollution sources at Iowa's lakes. Finally, respondents were asked about social media that they currently use and which news and social media outlets they use for sharing and gathering information about Iowa lakes.

Results of the 2014 survey are consistent with previous years. About 60% of Iowans visit a lake at least one time per year, with the average of 8 single-day trips made by those who responded to the survey. Visitation rates at Iowa's lake remain relatively stable (and high). Iowans do a variety of activities when they visit our lakes, including relaxing/picnicking, fishing, wildlife viewing, and boating. Lakes that have the highest visitation rates are near urban areas, and usually have above average water quality. Complete results from the 2014 survey can be viewed at:

http://www.card.iastate.edu/ag_policy_review/f15-lakes/.

Lake Restoration Program – Partnerships and Outreach

Local, State, and Federal Partnerships

In order to achieve lake restoration goals it is critical that the DNR form effective watershed partnerships. This includes partnerships at the local level, but also at administrative levels of government. Local, state and federal programs offer a multitude of programs for financial assistance to landowners for soil conservation and other water quality protection practices. The strategy pursued in the lake restoration program will be to seek out key individuals with expertise at the local level and the program administration level. This expertise will maximize access to financial incentives for landowner participation in watershed improvement and lake restoration projects. Listed below are several examples of potential partners in watershed improvement and lake restoration.

Local:

- Chamber of Commerce, City/Town Mayors and Councils
- Conservation and Recreation Clubs and Organizations
- County Board of Supervisors, County Conservation Board
- DNR Field Offices (Environmental Services, Fisheries, Forestry, Parks, Wildlife)
- IDALS/ Division of Soil Conservation and Water Quality– Project Coordinators
- IOWATER Volunteers / Educators / Interested Citizens
- Lake Associations / Groups / Watershed Organizations / Private Landowners
- Soil and Water Conservation Districts (SWCD)
- Resource Conservation and Development (RC&D)

State:

- IDALS/ Division of Soil Conservation and Water Quality
- Iowa Department of Transportation
- Iowa Environmental Council

- Iowa Farm Bureau
- Iowa Natural Heritage Foundation

Federal:

- U. S. Environmental Protection Agency / U.S. Fish and Wildlife Service
- Natural Resources Conservation Service
- U.S. Army Corps of Engineers / U.S. Geological Survey

Communication Tools and Strategies

The DNR, in cooperation with Iowa Department of Agriculture Land Stewardship (IDALS), has worked to develop a holistic approach to locally led watershed projects and information to help guide communities through the process of water quality improvement projects.

First Steps for Cleaner Water

<http://www.iowadnr.gov/Environment/WaterQuality/LakeRestoration.aspx>

Community Watershed Improvement Framework for Lakes

<http://www.iowadnr.gov/Environment/WaterQuality/LakeRestoration.aspx>

People will find these brochures useful as handouts at meetings. In addition to brochure type handouts, a number of communication and outreach tools for the public and lake stakeholders will be considered as deemed appropriate, including: display/kiosk, lake restoration tool kit and workshop, newsletters, opinion surveys, web site. For example, the Lakes Program developed a one-page handout that summarizes the Lake Restoration Process. This has proved to be a useful tool in communicate the important aspects of the program to the public.

Appendices

Appendix A. House File 2782 – Enrolled

PAG LIN

1 1 HOUSE FILE 2782

1 2

1 3 AN ACT

1 4 RELATING TO AND MAKING APPROPRIATIONS TO STATE DEPARTMENTS

1 5 AND AGENCIES FROM THE REBUILD IOWA INFRASTRUCTURE FUND,

1 6 ENVIRONMENT FIRST FUND, TOBACCO SETTLEMENT TRUST FUND,

1 7 VERTICAL INFRASTRUCTURE FUND, THE ENDOWMENT FOR IOWA'S

1 8 HEALTH RESTRICTED CAPITALS FUND, THE TECHNOLOGY REINVEST-

1 9 MENT FUND, THE ENDOWMENT FOR IOWA'S HEALTH ACCOUNT, THE

1 10 PUBLIC TRANSIT INFRASTRUCTURE GRANT FUND, THE IOWA GREAT

1 11 PLACES PROGRAM FUND, AND RELATED MATTERS AND PROVIDING

1 12 IMMEDIATE, RETROACTIVE, AND FUTURE EFFECTIVE DATES.

1 13

1 14 BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF IOWA:

31 13 Sec. 26. NEW SECTION. 456A.33B LAKE RESTORATION PLAN AND

31 14 REPORT.

31 15 1. It is the intent of the general assembly that the

31 16 department of natural resources shall develop annually a lake

31 17 restoration plan and report that shall be submitted to the

31 18 joint appropriations subcommittee on transportation,

31 19 infrastructure, and capitals and the legislative services

31 20 agency by no later than January 1 of each year. The plan and

31 21 report shall include the department's plans and

31 22 recommendations for lake restoration projects to receive

31 23 funding consistent with the process and criteria provided in

31 24 this section, and shall include the department's assessment of

31 25 the progress and results of projects funded with moneys

31 26 appropriated under this section.

31 27 The department shall recommend funding for lake restoration

31 28 projects that are designed to achieve the following goals:

31 29 a. Ensure a cost=effective, positive return on investment

31 30 for the citizens of Iowa.

31 31 b. Ensure local community commitment to lake and watershed

31 32 protection.

31 33 c. Ensure significant improvement in water clarity,

31 34 safety, and quality of Iowa lakes.

31 35 d. Provide for a sustainable, healthy, functioning lake

32 1 system.

32 2 e. Result in the removal of the lake from the impaired

32 3 waters list.

32 4 2. The process and criteria the department shall utilize

32 5 to recommend funding for lake restoration projects shall be as

32 6 follows:

32 7 a. The department shall develop an initial list of not

32 8 more than thirty=five significant public lakes to be

32 9 considered for funding based on the feasibility of each lake

32 10 for restoration and the use or potential use of the lake, if

32 11 restored. The list shall include lake projects under active

32 12 development that the department shall recommend be given

32 13 priority for funding so long as progress toward completion of

32 14 the projects remains consistent with the goals of this

32 15 section.

32 16 b. The department shall meet with representatives of
32 17 communities where lakes on the initial list are located to
32 18 provide an initial lake restoration assessment and to explain
32 19 the process and criteria for receiving lake restoration
32 20 funding. Communities with lakes not included on the initial
32 21 list may petition the director of the department for a
32 22 preliminary lake restoration assessment and explanation of the
32 23 funding process and criteria. The department shall work with
32 24 representatives of each community to develop a joint lake
32 25 restoration action plan. At a minimum, each joint action plan
32 26 shall document the causes, sources, and magnitude of lake
32 27 impairment, evaluate the feasibility of the lake and watershed
32 28 restoration options, establish water quality goals and a
32 29 schedule for attainment, assess the economic benefits of the
32 30 project, identify the sources and amounts of any leveraged
32 31 funds, and describe the community's commitment to the project,
32 32 including local funding. The community's commitment to the
32 33 project may include moneys to fund a lake diagnostic study and
32 34 watershed assessment, including development of a TMDL (total
32 35 maximum daily load).

33 1 c. Each joint lake restoration plan shall comply with the
33 2 following guidelines:

33 3 (1) Biologic controls will be utilized to the maximum
33 4 extent, wherever possible.

33 5 (2) If proposed, dredging of the lake will be conducted to
33 6 a mean depth of at least ten feet to gain water quality
33 7 benefits unless a combination of biologic and structural
33 8 controls is sufficient to assure water quality targets will be
33 9 achieved at a shallower average water depth.

33 10 (3) The costs of lake restoration will include the
33 11 maintenance costs of improvements to the lake.

33 12 (4) Delivery of phosphorous and sediment from the
33 13 watershed will be controlled and in place before lake
33 14 restoration begins. Loads of phosphorous and sediment, in
33 15 conjunction with in-lake management, will meet or exceed the
33 16 following water quality targets:

33 17 (a) Clarity. A four-and-one-half-foot secchi depth will
33 18 be achieved fifty percent of the time from April 1 through
33 19 September 30.

33 20 (b) Safety. Beaches will meet water quality standards for
33 21 recreational use.

33 22 (c) Biota. A diverse, balanced, and sustainable aquatic
33 23 community will be maintained.

33 24 (d) Sustainability. The water quality benefits of the
33 25 restoration efforts will be sustained for at least fifty
33 26 years.

33 27 d. The department shall evaluate the joint action plans
33 28 and prioritize the plans based on the criteria required in
33 29 this section. The department's annual lake restoration plan
33 30 and report shall include the prioritized list and the amounts
33 31 of state and other funding the department recommends for each
33 32 lake restoration project. The department may seek public
33 33 comment on its recommendations prior to submitting the plan
33 34 and report to the general assembly.

Appendix B. Significant, Publicly-owned Lakes – Defined

Bachmann (1980). “Clean Lakes Classification Study of Iowa’s Lakes for Restoration”.

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Iowa Cooperative Fisheries Research Unit, Iowa State University, Department of Animal Ecology

Introduction

Approximately 175 lakes and reservoirs were considered by the Iowa Conservation Commission (ICC) staff for inclusion into the list of lakes to be surveyed and classified. Many of these 175 lakes are contained in “Iowa Fishing Guide”, a publication of the ICC. Time and money precluded survey and classification of all the lakes; therefore, the list was reduced to include only significant lakes in public ownership.

Significant Lakes – Defined and Explained

Significant publicly-owned lakes were defined as those lakes which are principally maintained for public use containing a minimum surface area of 10 acres and capable of supporting fish stocks of at least 200 pounds per acre. Species diversity in water bodies containing less than 10 acres is habitually low resulting in a fish density with minimal potential for maximum sustained yields via sport or foodfish fisheries. Shallow lakes, which are most characteristic of wetlands and marsh-like habitat that are subject to chronic and extensive fish winterkills, were excluded from the survey. Establishment of productive fish populations is hopeless where massive mortality results from the lowering of life supporting oxygen concentrations under ice cover each winter. Federal-owned on-stream impoundment constructed for floodwater supplies were excluded because of Clean Water Act regulations. Multi-purpose lakes providing domestic water supply as only one of several major management objectives were included in the study. Impoundments containing a watershed to surface area ration greater than 200:1 acres were omitted from the list since they are mainly on-stream impoundments formed by lowhead dams and emulate riverine habitat rather than lake environment.

Section 305 (b) report (2000)

Section 314 (a) (2) of the federal Clean Water Act of 1987 requires each state to include in its biennial Section 305 (b) report specific information on the water quality conditions and trends of the state’s “significant, publicly-owned lakes,” as well as a description of the state’s lake protection and restoration programs. In Iowa, “significant, publicly-owned lakes” are defined as those publicly-owned lakes that meet all of the following criteria:

- are maintained principally for public use;
- are capable of supporting fish stocks of at least 200 pounds per acre;
- have a surface water area of at least 10 acres;
- have a watershed to lake surface area ratio of less than 200:1;
- are not shallow marsh-like lakes, federal flood control impoundments, or used solely as water supply reservoirs.

As such, the 115 significant, publicly-owned lakes (SPOLs) represent a subset of the Iowa’s approximately 5,400 lakes, ponds, and reservoirs.

Lake Restoration Program (2015)

For the purpose of Iowa’s Lake Restoration Program, “significant, publicly-owned lakes” are defined as those publicly-owned lakes that meet all of the following criteria:

- are maintained principally for public use;
- are multi use systems capable of supporting a viable sport fishery and recreational opportunities;
- have a surface water area of at least 10 acres;
- have a watershed to lake surface area ratio of less than 200:1;
- are not federal flood control impoundments (exception is Rathbun Reservoir due to a watershed to lake surface area ratio that is less than 200:1); and
- are not lakes used solely as water supply reservoirs.

Appendix C. Lake Restoration Prioritization Process and Program

Key Concepts and Facts

- Six of ten Iowans visit lakes each year; they will visit these lakes eight times during the year
- Iowans prefer lakes with better water quality
- Statewide our lakes generate \$1.6 billion in annual spending by Iowans
- A lake is a reflection of both watershed and lake management
- Lake restoration starts in the watershed; it relies on strong local involvement and voluntary participation of landowners

Current Prioritization and Program

- Modeled after the Federal Clean Lakes Program established in the 1970s
- DNR provided the 2006 legislature with a priority list of 35 lake candidates
 - Priorities based on a 5-year ISU/DNR assessment of water quality
 - Technical feasibility of restoration
 - Potential economic benefits
 - Use by Iowans, and local interest/involvement
- Projects require a lake and watershed restoration assessment and plan
- Projects require local resources in combination with state and federal funds
- Local groups can petition to have their lake added to the priority list
- Project Status
 - 24 Completed or near completion
 - 22 Active projects in-progress
 - 13 Initial public outreach, evaluation or planning stage
- DNR provides an annual progress report to the legislature that includes a work plan and budget

Water Quality Goals

Stipulated in 2006 State Legislation (HF2782):

- Delivery of phosphorous and sediment from the watershed will be controlled before lake restoration begins
- Shallow lakes management will be considered among options for restoration
- Water quality targets
 - Clarity. 4 ½ foot secchi disc transparency 50% of the time from April – September
 - Biota. A diverse, balanced, and sustainable aquatic community must be maintained
 - Impairment. Water quality impairments must be eliminated
 - Sustainability. The water quality and public use benefits must be sustained for 50 years

Lake Restoration Program Budget

- Funding from FY2007 through FY2016 of \$80.2 million (approximately \$8.0 million per year) has enabled the DNR to improve many Iowa's lakes and proceed with implementing projects at a number of our other priority systems

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Appendix D. Significant, Publicly-owned Lakes List

The below table includes the initial list of thirty-five significant publicly-owned lakes (lake systems) prioritized for the program based on the feasibility of each lake for restoration and the use or potential use of the lake, if restored. The list included lake projects under active development by the department so long as progress toward completion of the projects remained consistent with the goals of the program. In addition, are 24 lakes that have since been added to the list of lakes prioritized for the program after communities have successfully petitioned the director of the department or were ranked high by the Department in terms of their potential for meeting program goals. The table also indicates if a given lake is prioritized for funding under the current ten-year plan.

LAKENAME	CO_NAME	Original List of 35	Added to LRP	Current Ten Year
Arbor Lake	POWESHIEK	Y		Y
Badger Creek Lake	MADISON		Y	Y
Big Creek Lake	POLK	Y		Y
Black Hawk Lake	SAC	Y		Y
Blue Lake	MONONA	Y		Y
Brushy Creek Lake	WEBSTER	Y		
Carter Lake	POTTAWATTAMIE	Y		
Center Lake	DICKINSON		Y	Y
Central Park Lake	JONES	Y		Y
Clear Lake	CERRO GORDO	Y		
Crystal Lake	HANCOCK	Y		
Diamond Lake	POWESHIEK	Y		Y
Easter Lake	POLK	Y		Y
Five Island Lake	PALO ALTO	Y		Y
George Wyth Lake	BLACK HAWK	Y		Y
Green Valley Lake	UNION	Y		
Hannen Lake	BENTON	Y		Y
Hawthorn Lake	MAHASKA		Y	
Hickory Grove Lake	STORY	Y		Y
IA Great Lakes	DICKINSON	Y		Y
Kent Park Lake	JOHNSON	Y		Y
Lacey Keosauqua Lake	VAN BUREN		Y	Y
Lake Ahquabi	WARREN	Y		
Lake Anita	CASS	Y		
Lake Darling	WASHINGTON	Y		
Lake Geode	HENRY	Y		Y
Lake Icaria	ADAMS		Y	
Lake Keomah	MAHASKA	Y		Y
Lake Macbride	JOHNSON	Y		
Lake Manawa	POTTAWATTAMIE	Y		Y
Lake Miami	MONROE		Y	Y
Lake of the Hills	SCOTT	Y		Y
Lake of Three Fires	TAYLOR		Y	

Lake Name	County	Original List of 35	Added to LRP	Current Ten Year
Lake Sugema	VAN BUREN		Y	
Lake Wapello	DAVIS		Y	
Little River Lake	DECATUR		Y	
Little Wall Lake	HAMILTON	Y		
Lizard Lake	POCAHONTAS		Y	
Lost Grove Lake	SCOTT		Y	
Lost Island Lake	PALO ALTO		Y	
Mariposa Lake	JASPER		Y	Y
Meadow Lake	ADAIR		Y	
Otter Creek Lake	TAMA		Y	Y
Pine Lakes - Upper/Lower	HARDIN		Y	Y
Pleasant Creek Lake	LINN	Y		Y
Prairie Rose Lake	SHELBY	Y		
Rathbun Reservoir	APPANOOSE		Y	Y
Red Haw Lake	LUCAS	Y		
Rock Creek Lake	JASPER	Y		Y
Silver Lake	DICKINSON		Y	Y
Silver Lake	PALO ALTO		Y	Y
Silver Lake	DELAWARE	Y		Y
Storm Lake	BUENA VISTA	Y		Y
Swan Lake	CARROLL		Y	Y
Three Mile Lake	UNION		Y	Y
Twelve Mile Creek Lake	UNION		Y	
Twin Lakes - North/South	CALHOUN		Y	Y
Union Grove Lake	TAMA	Y		Y
Viking Lake	MONTGOMERY	Y		

*Note – IA Great Lakes (Dickinson) includes Big Spirit Lake (incl. Little Spirit Lake), East Okoboji Lake, Lower Gar Lake, Minnewashta Lake, Upper Gar Lake and West Okoboji Lake

The following table includes other lakes recognized by the Iowa Department of Natural Resources Lake Restoration Program as Significant Publicly-Owned Lakes.

Lake Name	County
Arrowhead Lake	SAC
Arrowhead Pond	POTTAWATTAMIE
Avenue of the Saints Pond	BREMER
Badger Lake	WEBSTER
Beaver Lake	DALLAS
Beeds Lake	FRANKLIN
Belva Deer Lake	KEOKUK
Big Hollow Lake	DES MOINES
Bob White Lake	WAYNE
Briggs Woods Lake	HAMILTON
Browns Lake	WOODBURY

LAKE NAME	COUNTY
Casey Lake (Hickory Hills Lake)	TAMA
Cold Springs Lake	CASS
Crawford Creek Impoundment	IDA
DeSoto Bend	HARRISON
Dog Creek (Lake)	OBRIEN
Don Williams Lake	BOONE
East Lake (Osceola)	CLARKE
Eldred Sherwood Lake	HANCOCK
Fogle Lake S.W.A.	RINGGOLD
Green Belt Lake	BLACK HAWK
Green Castle Lake	MARSHALL
Greenfield Lake	ADAIR
Hooper Area Pond	WARREN
Indian Lake	VAN BUREN
Ingham Lake	EMMET
Iowa Lake	IOWA
Lake Cornelia	WRIGHT
Lake Hendricks	HOWARD
Lake Meyer	WINNESHIEK
Lake Pahoja	LYON
Lake Smith	KOSSUTH
Little Sioux Park Lake	WOODBURY
Littlefield Lake	AUDUBON
Manteno Park Pond	SHELBY
Meyer Lake	BLACK HAWK
Mill Creek Lake	OBRIEN
Mitchell Lake	BLACK HAWK
Moorhead Park Pond	IDA
Mormon Trail Lake	ADAIR
Nelson Park Lake	CRAWFORD
Nine Eagles Lake	DECATUR
Nodaway Lake	ADAIR
Oldham Lake	MONONA
Orient Lake	ADAIR
Ottumwa Lagoon	WAPELLO
Pierce Creek Pond	PAGE
Poll Miller Park Lake	LEE
Roberts Creek Lake	MARION
Rodgers Park Lake	BENTON
Rudd Lake	FLOYD
Silver Lake	WORTH
Slip Bluff Lake	DECATUR
Snyder Bend Lake	WOODBURY
South Prairie Lake	BLACK HAWK
Spring Lake	GREENE

Lake Name	County
Springbrook Lake	GUTHRIE
Summit Lake	UNION
Thayer Lake	UNION
Volga Lake	FAYETTE
West Lake (Osceola)	CLARKE
White Oak Lake	MAHASKA
Williamson Pond	LUCAS
Willow Lake	HARRISON
Wilson Park Lake	TAYLOR
Windmill Lake	TAYLOR
Yellow Smoke Park Lake	CRAWFORD